The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

June 1942

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PHILIP SYNG PHYSICK (1768-1837). Although occasional reference to absorbable sutures is found in early surgical literature, this famous Philadelphian was responsible for their actual development. In the disintegration of leather when exposed to tissue fluids, he saw the possibility of eliminating wound complications caused by the prolonged presence of non-absorbable ligatures. Buckskin, parchment and kid were tried with encouraging results but catgut was found to be the most satisfactory.

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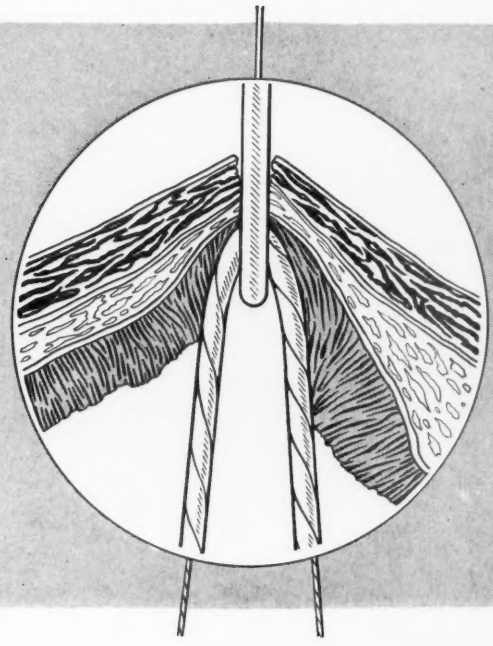

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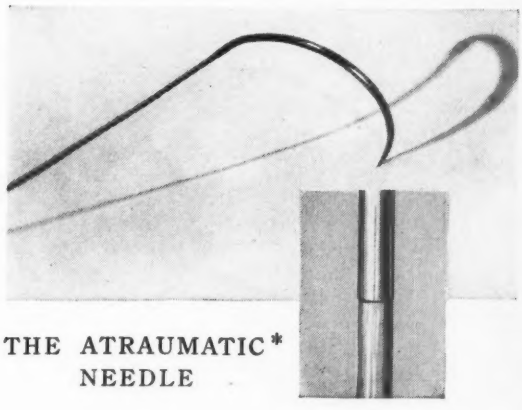

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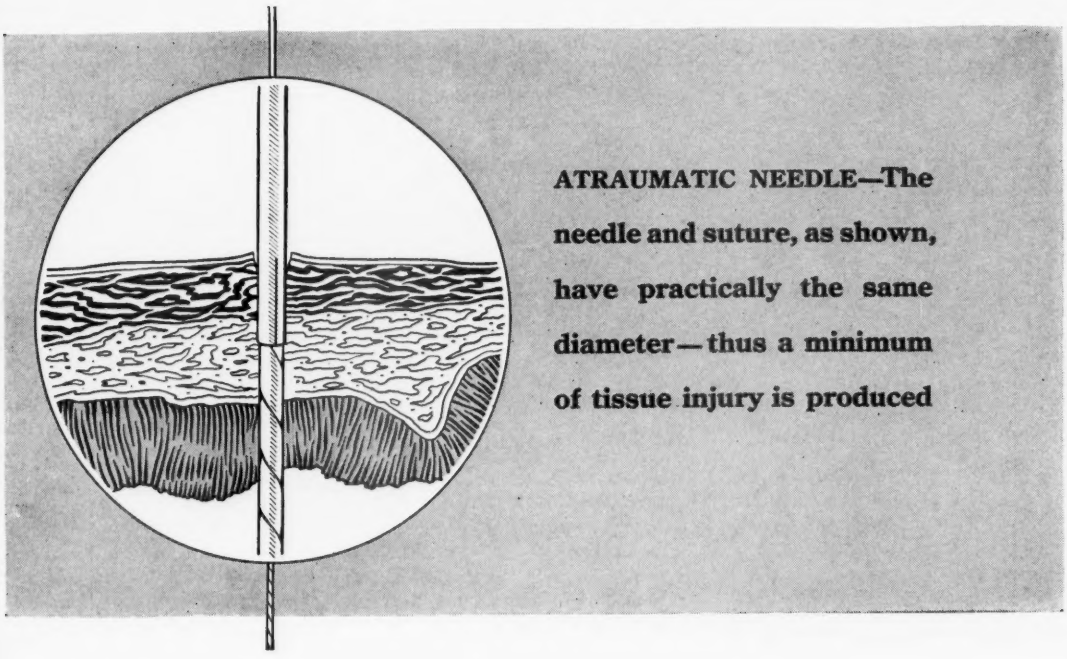

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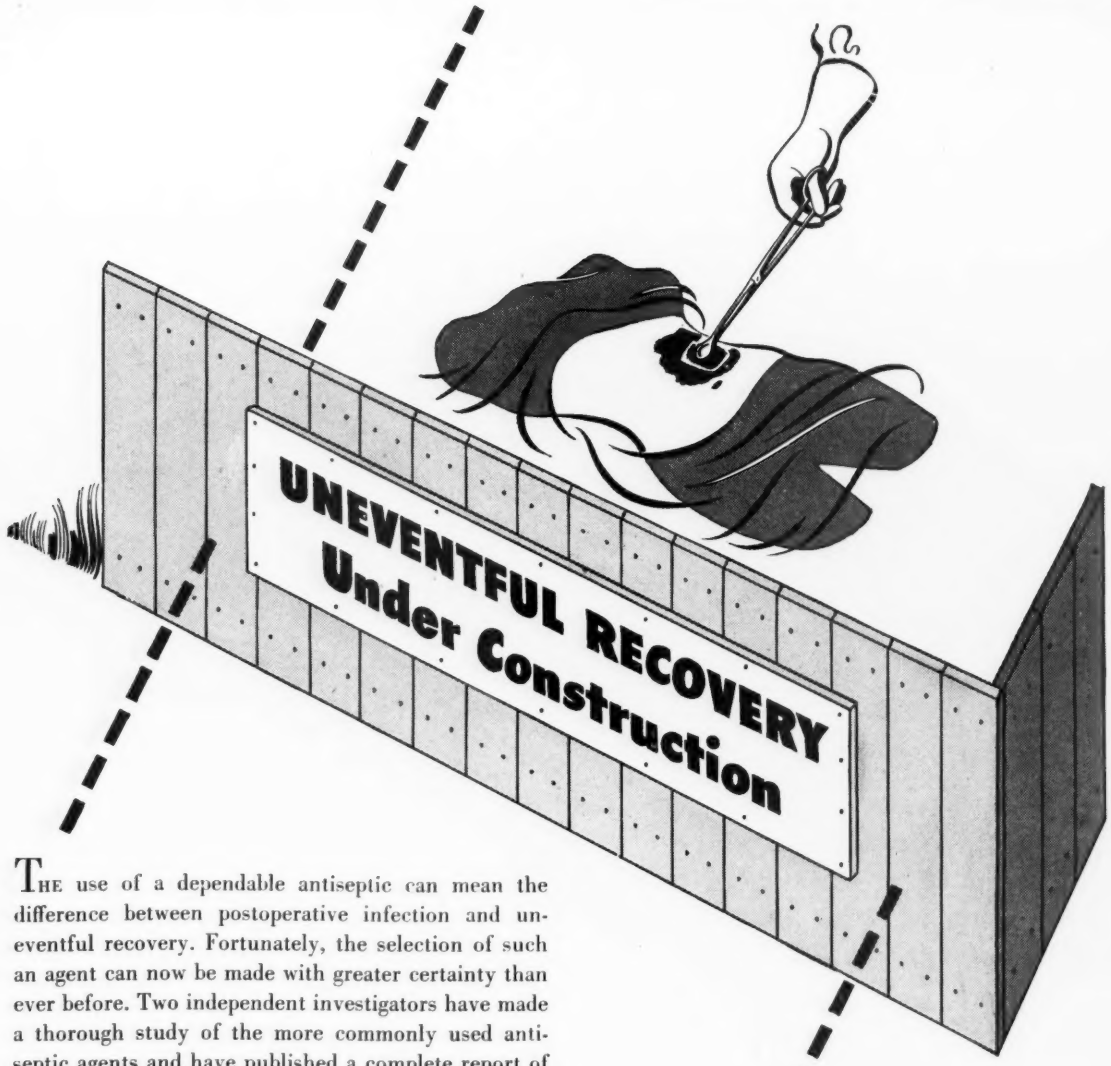

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* Meyer, E., and Arnold, L. (1938), Amer. J. Digest. Dis., 5:418

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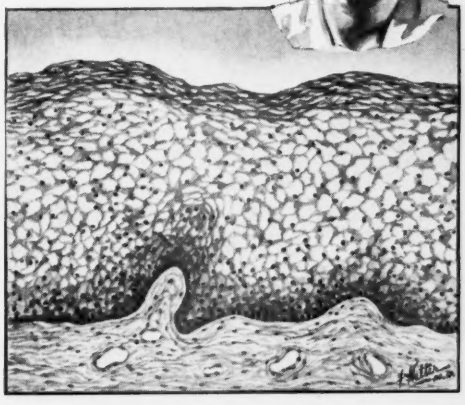

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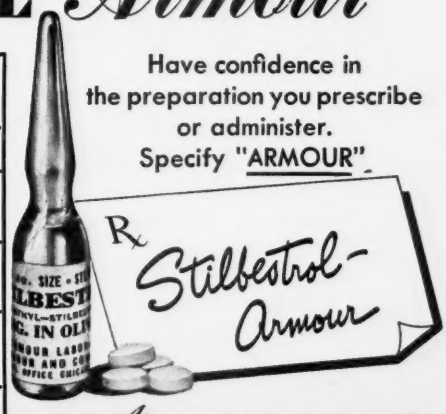

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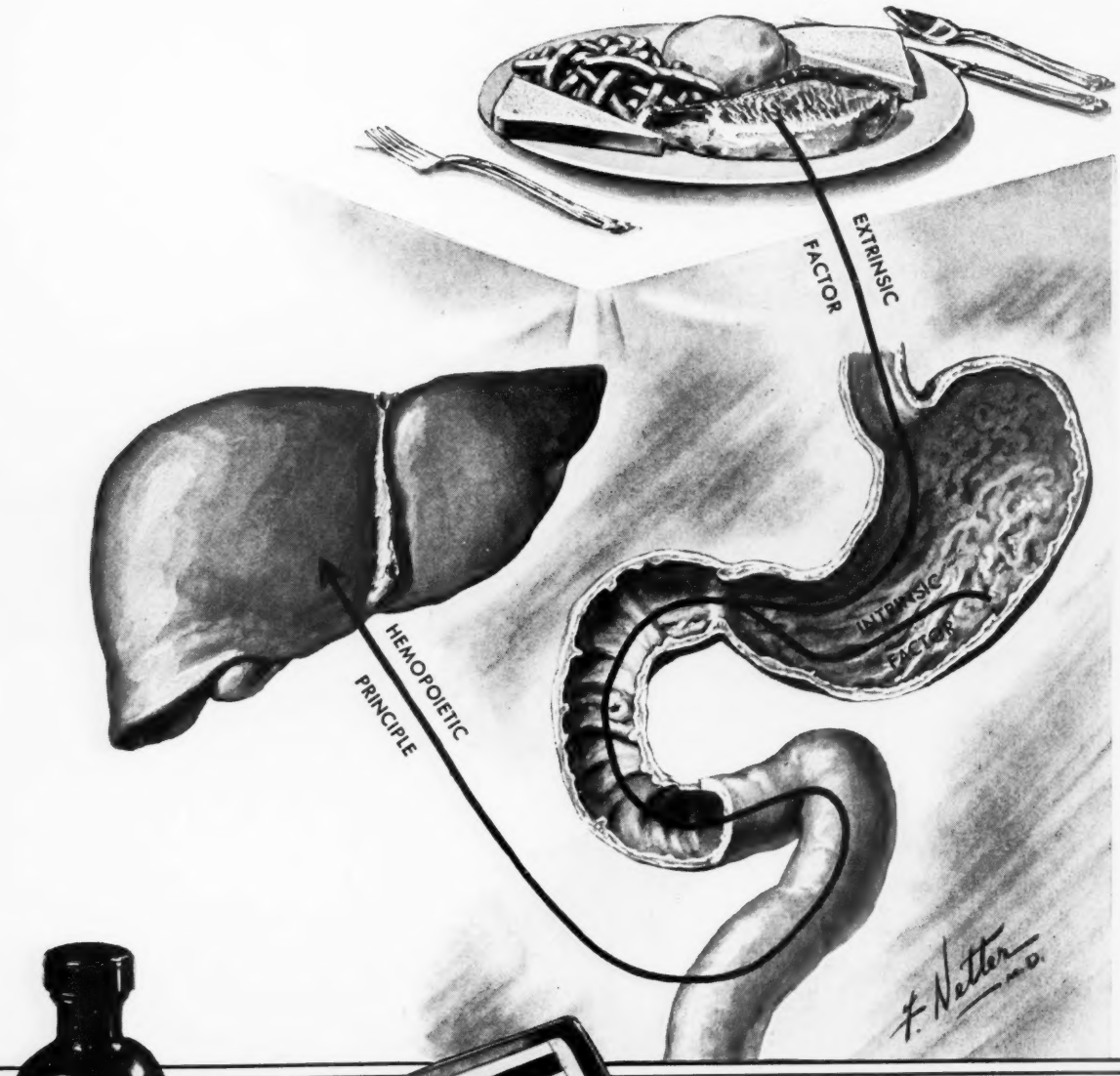

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Castle and his associates (1, 2) have shown that the hemopoietic principle is normally produced as a result of the interaction of the *extrinsic factor* from food and the *intrinsic factor* derived from the gastric juice. The resultant product is then stored in the liver.

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(1) *Castle, W. B, and Townsend, W. C.: Am. J. Med. Sci.; 178 p. 764 (1929)*
(2) *Castle, W. B., Townsend, W. C. and Heath, C. W.: Am. Jl. Med. Sci.; 180 p. 305 (1930)*
(3) *Musser, J. H. and Wintrobe, M. M.: Tice, Practice of Medicine, Prior Vol. VI, P. 825*

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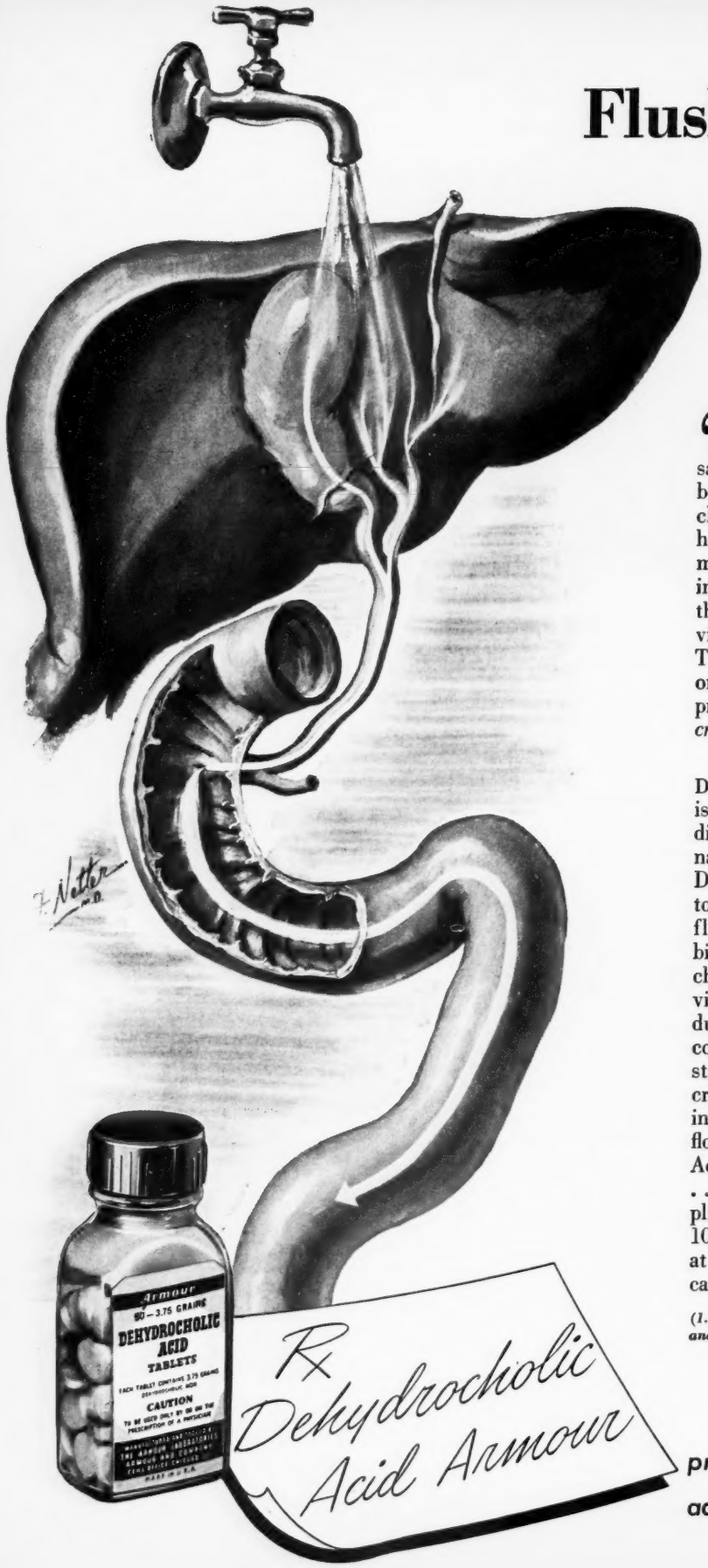

Flushing Out the Bile Passages

THE bile acids (Taurocholic acid and Glycocholic acid) and their sodium salts are recognized pharmacologically as being among the most powerful known choleretics. Ivy and his collaborators (1), however, have pointed out that while administration of the natural acids or salts increases the flow of bile, it also increases the output of dissolved solids so that the viscosity of the bile actually becomes greater. The oxidized or keto form of these acids, on the other hand, produces an even more profuse biliary flow but simultaneously *increases its fluidity.*

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(1.) Berman, A. L.: Snapp, E.; Ivy, A. C.; Atkinson, A. J.; and Houch, U. S.: Am. J. Digest, Dis.; Vol, VII; No. 8; pp. 336, 346.

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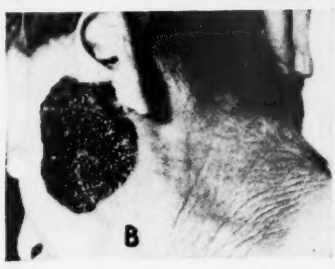

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*Veal, J. R.; Klepser, R. G.; and DeVito, Michael P. (American Journal of Surgery, Vol. 54, No. 3, Dec. 1941, 716).
**Veal, J. R.; and Klepser, R. G. (Surgery, Vol. 10, No. 6, Dec. 1941, 947).

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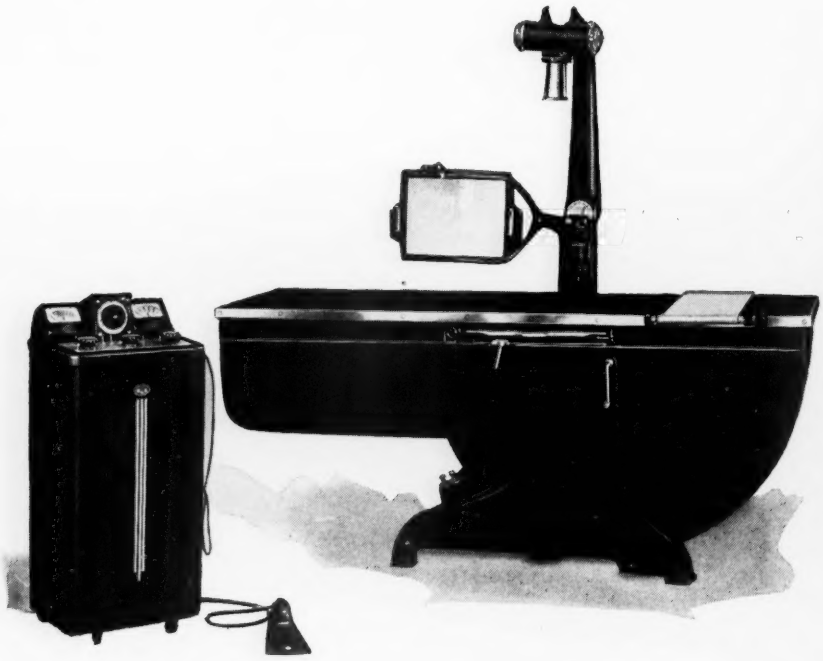

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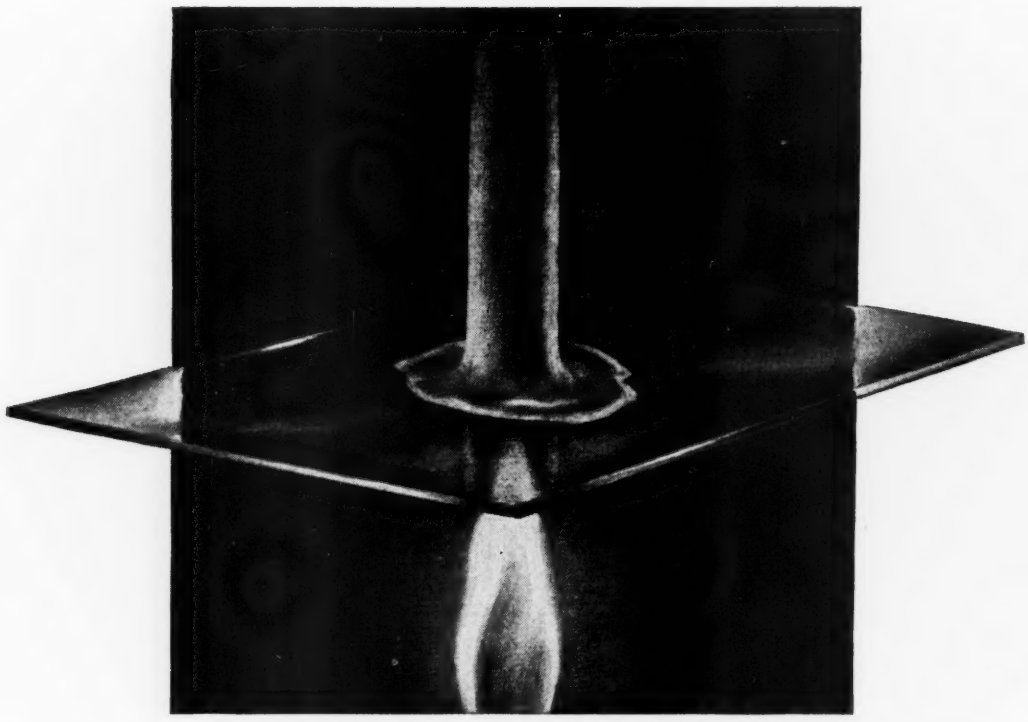

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[1]Gillespie, N. A.: *Anesthesiology* 1:292 (Nov.) 1940.

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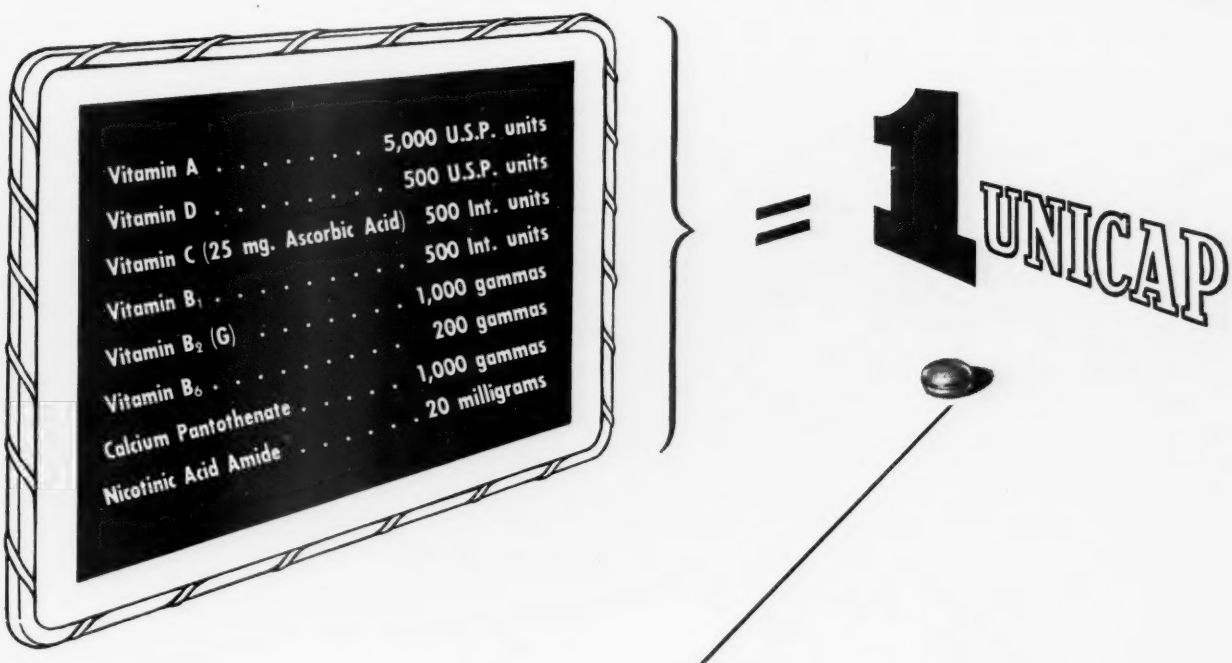
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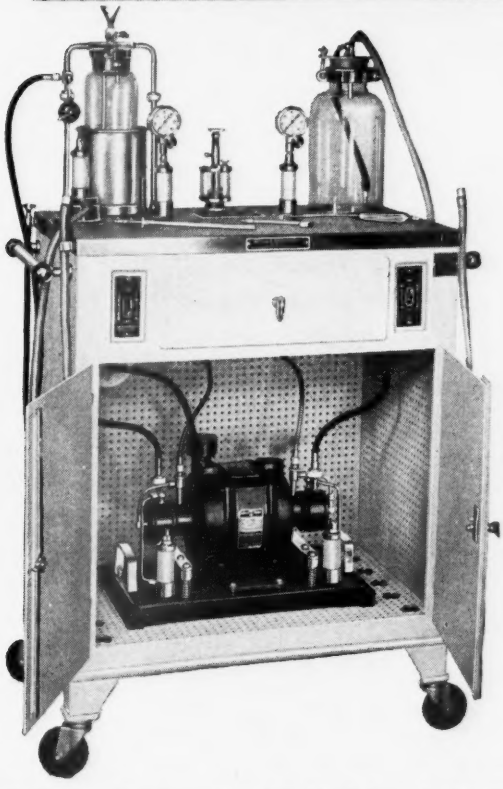

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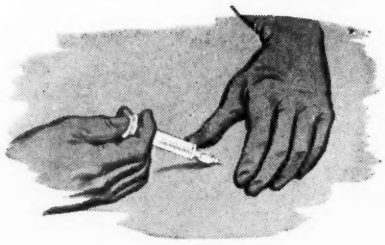

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NEW SERIES VOL. LVI JUNE, 1942 NUMBER THREE

Editorials

LIMITATIONS AND POSSIBLE HAZARDS OF ENDOCRINE TREATMENT IN GYNECOLOGY

GYNECOLOGISTS have long prided themselves that their own particular segment of the rich field of endocrinology has been more productively worked than has almost any other. While this is probably true, the explanation is that gynecology has profited by the fortuitous circumstance that it is so largely concerned with disturbances of the female reproductive phenomena, and that amazing advances have been made in our knowledge of the endocrinology of this intricate reproductive mechanism. In these advances many gynecologists have been eager allies of the laboratory investigators who deserve the chief credit for the advances made during the past quarter century or so.

The endocrine treatment of functional gynecological disease, if it is to be rational, must conform, insofar as possible, with what appears to have been established by sound investigative methods, so that it is no longer necessary to emphasize that the well trained gynecologist must be familiar with the fundamentals of female endocrinology. There are still many gaps in our knowledge, and it has long been clear that many of the results of animal experimentation cannot be applied to the animal with which the gynecologist works, the human female. Realization of this fact has in recent years done much to lessen the enthusiasm of our attempts to apply clinically the steady stream of new knowledge flowing from the laboratories. I well recall the eagerness with which the discovery of the "female sex hormone" was greeted as possibly solving such tough therapeutic problems as the treatment of amenorrhea, and of the aftermath of clinical disappointment. The same disillusionment came after the brilliant laboratory demonstration of the domination of ovarian function by the gonadotropes of the pituitary. After fifteen years these hormones have not yet been isolated, and the gonadotropic principles as yet available have not materially improved our clinical results in the treatment of such disorders as amenorrhea and sterility, in certain types of which they would reasonably be expected to be of help. These examples might be multiplied.

A very large proportion of the thousands of papers which have been devoted to the therapeutic applications of the endocrines in gynecology are obviously unsound and uncritical, serving only to mislead the uninformed reader and perhaps to disgust those better qualified to detect the fallacies with which they so often abound. Nor are the skirts of laboratory investigators al-

together clean, for their literature likewise is richly spotted with "scheinwissenschaft," to borrow a term from the language of our present enemies.

For clinicians especially a hard-boiled skepticism is certainly a safer attitude than the naive overenthusiasm exhibited by many writers, and yet it may be overdone. There are some who appear to have cultivated a pose of extreme skepticism, even in the face of genuine knowledge honestly arrived at, simply because such an attitude, mistakenly labeled as conservative, appears impressive and oracular. A few writers have been consistent and sincere "debunkers," and they have done much to counteract the baneful influence of misguided enthusiasts, aided and abetted by some of the less scrupulous manufacturers of gland products.

With no thought of assuming the oracular rôle which has just been criticized, I should like to set down, in a rather aphoristic fashion, a few items which serve to illustrate the limitations and even possible hazards of gynecological organotherapy. This list, which could be expanded at considerable length, has to do with the negative side of the endocrine ledger. There is no attempt at elaboration or controversial discussion, but I believe that the statements made will be endorsed by all well informed gynecologists and endocrinologists; some are almost trite:

1. Now that the two ovarian hormones, estrogen and progesterone, are readily available in pure form, there is no excuse for the use of the old fashioned tablets, capsules and solutions of ovarian substance, ovarian residue or corpus luteum which formerly were so universally employed in the treatment of ovarian deficiency, real or supposed. If this seems to be an unnecessary injunction, let me remind the reader that considerable quantities of such preparations, almost or entirely lacking in hormonal activity, are still produced by even high-grade manufacturers, simply because of the demand for them by physicians who have failed to keep up with the times.

2. The estrogenic substances do not stimulate the ovary, and in large doses they inhibit its function, so that their administration cannot be expected to start the ovarian mechanism. Their employment in the treatment of amenorrhea is therefore substitutional, and it rarely enhances the patient's chances for correction of the sterility which is so commonly associated with endocrinopathic amenorrhea.

3. The valuable new nonhormonal chemical stilbestrol should still be handled circumspectly, but there is every reason to believe that in proper dosage its use is perfectly safe. When thus used the incidence of unpleasant but not dangerous toxic symptoms is much lower than was noted in the days of its experimental use, when unnecessarily large doses were often employed. Personally, I believe this substance to be a genuine boon in the treatment of menopausal symptoms, in view of its inexpensiveness and its high degree of estrogenic potency by oral administration.

4. There has been much discussion and considerable apprehension concerning the possibility that estrogenic therapy might in some cases lead to the development of cancer. The question is too big a one to discuss here in all its angles. Suffice it to say that there is no worth-while evidence to indicate that the estrogens in any reasonable therapeutic dose can have any such effect in the human. Even large doses have appeared to carry no such hazard, but the wise clinician will nevertheless avoid unnecessarily large or promiscuous estrogenic dosage, perhaps even more for other reasons than because of a cancer hazard. He will certainly wish to be circumspect in the employment of estrogens in patients in whom, either on the basis of family history or because of the existence of some precancerous lesion, a predisposition to cancer may be properly suspected. On the other hand, it would seem farfetched and unjustified, in the present state

of our knowledge, to deprive women of the often very real advantages of estrogenic treatment because of the vague specter of cancer hazard.

5. No gonadotropic principle of undoubted efficacy in the human is as yet available. Efforts to prepare such active extracts from the pituitary gland itself have thus far been unsuccessful. The effect of various gonadotropic principles on the human ovary has yielded no clear-cut evidence of distinctive effects, and many good observers have reported no worthwhile effects of any kind. It is not surprising, therefore, that the clinical results with preparations of this general group have been so generally disappointing.

6. One of the most abused of all forms of endocrine therapy during the past few years has been the indiscriminate use of the equine gonadotropic principle, obtained from pregnant mare serum, in the treatment of sterility. The offense is particularly flagrant when such treatment is resorted to, as it often is, without proper preliminary investigation as to the possible causes of the sterility. In only a small proportion of cases, more especially those of so-called anovulatory type, is there a justification for treatment of this sort, and even in this group the results are disappointing. There is no certainty that even harmful results may not be caused by the careless use of these preparations.

7. The employment of various hormones in the treatment of certain cases of primary dysmenorrhea and functional bleeding is justified and indicated. This is not the place to discuss details, but it is the place to emphasize that a great many disappointments are bound to be encountered in the treatment of both of these disorders, if endocrines are relied on to the exclusion of other measures. This is particularly true with dysmenorrhea.

8. The employment of androgenic hormone principles, usually in the form of testosterone propionate, has achieved wide vogue in the treatment of certain cases of functional bleeding and primary dysmenorrhea, and the results frequently justify the method. The fact that hirsutism and other masculinization symptoms may at times occur has made many clinicians hestitate in employing this substance. Certainly, the dosage employed by some has been too large, with much greater risk of unpleasant sequelae under such circumstances. The available evidence would indicate that with smaller doses, usually not exceeding 200 mg. a month, and often much less, the risk is very slight. The possibility of these sequelae, transitory though they may be, is nevertheless a genuine disadvantage of this treatment, and it should certainly be avoided in patients who already have a tendency to hypertrichosis or excessive pigmentation.

While some of the above comments may seem quite pessimistic, there is, as a matter of fact, no reason for discouragement as to what has actually been accomplished in this field within our own generation, far more than was accomplished in all preceding generations put together. However, these accomplishments are pretty well emblazoned in the literature, while the limitations and hazards of organotherapy will still bear frequent re-emphasis. It is lamentable but true that many physicians too quickly and too indiscriminately resort to "shots" of one form or another without adequate study of the individual problem, and without making an effort to acquire at least an elementary knowledge of female endocrinology. Without the latter, intelligent organotherapy is simply out of the question; and even when endocrine therapy appears to be intelligent, it is all too frequently disappointing. Nothing is more certain, however, than that our rapidly growing knowledge of endocrinology and biochemistry will with each year yield a measure of improvement in therapeutic results.

Emil Novak, M.D.

THE INDUSTRIAL HOSPITAL*

I THINK there is no more opportune time to write on this subject than now. What with a new war and with the increasing accidents, this subject can well be considered.

Since 1902, I have indulged in the practice of industrial or traumatic surgery. During the past war I was fortunate enough to be assigned to the British army and eventually taught bone and peripheral nerve surgery in the hospital, an experience which was very much to my benefit.

Many times since my return young and older doctors have asked me where they could go to obtain a post-graduate course on this subject as well as occupational diseases, which is now a part of the compensation laws of almost all the states in our country. I was unable to give them any tangible answer.

When Dr. Franklin Martin was living he called a meeting in Chicago of a number of men doing this work. At this meeting were deans of three universities. Dr. Martin's question was: What could be done to introduce this department? I was the first called upon. I frankly stated that the first criticism would lie at the door of the medical schools in that they did not have a chair competently filled by one who could and would teach the subject. Graduates came to me asking for an opportunity to work with me because they did not get sufficient training in their schools and I still get the same complaint.

At that time I had eight assistants in my office from different schools and it was deplorable what they did not know about the technic of the reduction of fractures, the proper application of splints and the treatment of other types of bodily injuries.

To my surprise at this meeting two other very competent industrial surgeons got up and more than doubted what I had said. This produced some consternation. Dr. Martin asked the deans about this and they frankly admitted they had not concentrated on the matter.

I believe that if we had in the larger cities in this country a hospital devoted to nothing but traumatic surgery and occupational diseases, it would be a boon not only to the general practitioner but the injured man as well. And if included in that hospital was a layman who could teach the business end and show the post-graduate student how to make out and follow up reports, it would be invaluable to the companies who depend upon the doctor to know just what the situation is. There is no doubt in my mind but that the industrially trained doctor would be only too glad to go on the staff of such an institution for the good of humanity alone.

Incidentally, such highly trained men would get referred surgery from the country practitioner when the latter got into deep water, which we all do no matter how well trained. The man who will not accept consultation when advisable is a menace. A hospital of this kind in the different cities would make it more accessible to the local man who has little time to spare and cannot meet the expense of a long trip. He would also learn the compensation laws of his own state.

Many readers will probably say their hospital is completely equipped with everything germane to this subject. Such is not the case, for I have been in many hospitals in this country and they do not have the equipment, while an industrial hospital in the different cities would have to have it or cease to exist.

Somebody may say "That is fine, but who is going to build that hospital?" My first answer is that in all the larger cities there is some man of wealth who wants to perpetuate his name. I do not think a finer thing could be done by such a man than to put his money into such an institution and have it called the John Jones Industrial or Traumatic Hospital. The other angle would be general contribution.

Finally, as medical men we should be big enough to accept this situation instead of trying to centralize it all in one or two institutions. I talked to a number of young graduates as well as older men and without exception they were all enthusiastic both for the schools and hospitals.

C. R. G. FORRESTER.

*Since the writing of this editorial, Dr. C. R. G. Forrester passed away.

The Dawn of Abdominal Surgery

BY DEAN CORNWELL, N. A.

Courtesy John Wyeth & Brother, Philadelphia

The Dawn of Abdominal Surgery

Doctor Ephraim McDowell about to perform the first ovariotomy on Jane Todd Crawford, Danville, Kentucky, 1809.

BY DEAN CORNWELL, N. A.

FOURTH IN THE SERIES "PIONEERS OF AMERICAN MEDICINE"

THE DAWN OF ABDOMINAL SURGERY*

EPHRAIM McDOWELL PERFORMING THE FIRST OVARIOTOMY ON JANE TODD CRAWFORD IN DANVILLE, KENTUCKY, 1809

DEAN CORNWELL

IN the fall of 1809, Dr. Ephraim McDowell, a young surgeon trained at Edinburgh, who had set up practice in the pioneer community of Danville, Kentucky, was called to examine a Mrs. Jane Todd Crawford who lived at Greenville, Kentucky, sixty-five miles from Danville. Her local physicians had examined her and diagnosed a pregnancy but the woman's term was overdue and they could not effect a delivery. Dr. McDowell diagnosed the condition as ovarian tumor and after consulting with the woman and her husband, Mrs. Crawford agreed to go to McDowell's home in Danville and be operated upon. Early in December, 1809, Mrs. Crawford rode on horseback the sixty-five miles to Danville and on Christmas Day, 1809, she was operated upon in a second floor room in Dr. McDowell's own home.

History does not record any successful abdominal operation up to this time and the concensus of medical opinion was opposed to it. Within the next few years, however, Dr. McDowell performed the same operation thirteen times, eight of which were successful. But neither this operation nor any other abdominal procedure was commonly accepted in general practice by the medical profession for another fifty years.

Mr. Cornwell went to Danville last fall and spent a full day sketching in the very room in the McDowell home in which the operation was performed for the purpose of getting the proper background. The artist also made two trips to Washington, D. C., using the well known statue of McDowell, presented by the State of Kentucky to the Capitol Building, as one of the sources for the surgeon's portrait.

These colored inserts have been supplied through the courtesy of the John Wyeth & Brother, Inc.

* "The Dawn of Adominal Surgery," which constitutes the fourth large painting in the series, "Pioneers of American Medicine," painted by Dean Cornwell, will be unveiled at the Annual Convention of the American Medical Association at a luncheon on Monday, June 8, at Hotel Traymore, Atlantic City, New Jersey.

Original Articles

THE SYNDROME OF THE ROLANDIC VEIN*

(HEMIPLEGIA OF VENOUS ORIGIN)

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INTRODUCTION

THE disturbances, resulting from interference with the cerebral venous circulation, because of their relative infrequency have not received the concentrated attention of clinical investigators. Even so most of the literature concerned with the cerebral venous system is largely based on the great venous channels, the cavernous, superior sagittal, lateral and straight sinuses, while the changes incident to interruption of the cerebral veins have received scant mention. There has been a tendency to treat the cerebral veins as more or less useless structures devoid of physiological importance.[1] In the meager reports there have been few clinical descriptions of the motor and sensory changes to be expected from obstruction of the cerebral veins, of a nature sufficiently definitive so that the diagnosis of such occlusions can be made with the same confident certainty manifested in evaluating arterial lesions.

However, there has been slowly accumulating information with respect to the physical symptoms resulting from interruption of the drainage of the rolandic vein, so that the suspicion of such interference can be entertained with increasing confidence. The ideal basic situation for such a suspicion occurs when a prior disease exists in or near the superior sagittal sinus, such as infection, a tumor involving or adjacent to the sinus, or trauma to the sinus. This paper is concerned with a further elaboration of the syndrome of the rolandic vein.

LITERATURE

The present concept of the physical characteristics of a hemiplegia induced by obstructing the drainage of the superior cerebral veins was first postulated by Holmes and Sargent.[2] Their conclusions were based on a war experience with over seventy cases of traumatic damage to the sagittal sinus, injury to which produced a flooding in the drainage area of the rolandic veins. The clinical signs observed by them were described as a hemiplegia most marked in the lower extremity, frequently sparing the hand and face, with early muscular rigidity singular in quality and sensory disturbances of the gnostic type.

Previously Gowers,[3] in 1888, suggested that a hemiplegia observed under certain conditions could well have been produced by a thrombosis of the cortical veins, and noted that such hemiplegias were observed in patients dying of tubercular meningitis in whom thrombosis of the contralateral cerebral veins was found. Still earlier* Dusch,[4] in 1861, without attempting to correlate the clinical and pathological

* I am indebted to Orthello Langworthy for this reference.

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observations, depicted similarly thrombosed cerebral veins in a hemiplegic woman who died from postpartum septicemia. Wimmer[5] noted right-sided focal signs in a patient in whom at postmortem examination an extension was found of a thrombosis of the superior longitudinal sinus into the left superior cerebral veins. Lannois[6] described a syndrome of ascending hemiplegia, characterized by hemiparesis and disturbances of gnostic sensibilities which he attributed to thrombophlebitis of the superior sagittal sinus. Chalier and Naussac[7] reported the development of a terminal left hemiplegia and left-sided convulsions in a child who finally succumbed to a series of acute illnesses, the final phase being related apparently to a discharging right ear, without associated chills or fever. At postmortem examination there was thrombotic involvement of the superior longitudinal sinus with extension into the tributary superior cerebral veins particularly on the right.

Clear cut involvement of the cerebral veins without implication of the sagittal sinus in cases in which a contralateral hemiplegia was observed was noted by Davis,[8] Waggoner,[9] and Dowman.[10] In Davis' case extensive thrombosis of the left rolandic vein and its branches was found at operation and at necropsy in a patient who presented a right-sided hemiplegia with astereognosis in the right hand and hypesthesia. In Waggoner's case at postmortem examination extensive thrombosis of the left rolandic vein was disclosed. This patient developed a right hemiplegia sudden in onset. No convulsive attack or loss of consciousness occurred. There was no facial paralysis, no loss of speech and no loss of sphincteric control. The right leg was paralyzed and weak. Mild right-sided pyramidal signs were observed. Astereognosis was found in the right hand without loss of tactile pain or temperature sensibilities. Gradually, power returned to the right upper limb but he remained unable to use the right lower extremity.

In Dowman's patient, who recovered at operation, the right rolandic vein was found to be large, bluish-black with compensating dilatation of neighboring veins, and with an excessive amount of fluid in the sulci. This patient complained of a gradually developing numbness over the left half of the body beginning in the face and slowly involving the left leg. The left hand was awkward. There developed weakness of the left hand and forearm. Loss of joint sense in the left fingers and of position sense in the left lower limb, with an exaggeration of the deep reflexes on the left were found. Dowman also noted the occurrence of a left hemiparesis after ligation of the right rolandic vein in the course of a transcortical approach to the third ventricle.

Recently three cases of "venous hemiplegia" developing after surgical interference with the superior cerebral veins adjacent to the sinus were reported.[11] These cases briefly abstracted are as follows:

CASE REPORTS

Case 1. In a left-handed female, aged fifty, who had normal preoperative physical findings and who suffered from convulsive seizures of two years' duration, a parasagittal meningioma was removed from the left posterior parietal area. The tumor was easily accessible and was removed with minimal trauma to the adjacent cortex and without interfering with the arterial supply. It was necessary to occlude several large veins adjacent to the tumor and emptying into the sagittal sinus.

On the same day following the operation there was a flaccid paralysis of the right arm and leg. No facial paralysis or disturbance of speech were noted. The following day movements of the fingers of the right hand occurred. The third day a good grip in the right hand with slight movements at the right elbow were found. Astereognosis was noted in the right hand. There was "plastic hypertonicity" in the right upper extremity when moved passively. On the eighth day weak movements returned to the right shoulder and hip. Appreciation of vibration and the two-point test was impaired in the right hand. Muscle, joint and tendon sense was disturbed in the right toes. Pain sensibility was slightly diminished. By the twenty-fifth day there was a complete return of motor func-

tion except for diminution of movements of the right toes.

Case II. A female, aged fifty-four, with a story of convulsive seizures for ten years, and dragging of the right leg for ten years, developed a right hemiparesis characterized by preservation of finger movements and grip, and absence of movements at the right elbow, shoulder and lower extremity. Marked plastic hypertonicity of the right extremities was observed. On the right there was found a mild sensory diminution to all modalities of sensation but chiefly the discriminative types. There was no facial paralysis and no defect in speech, despite a story of obvious right-handedness. A preoperative diagnosis was made of a left parasagittal meningioma and venous thrombosis of the cerebral veins was confirmed. A complete right hemiplegia except for face and speech was noted after operation. There occurred a progressive recovery of motor function following the cellular pattern of the rolandic strip.

Case III. A woman of sixty-two presented clinical signs of a "sensory hemiplegia" of progressive development. Motor power was excellent and there were no clinical signs of intracranial hypertension. Diagnostic air studies indicated a neoplasm in the posterior aspect of the right cerebrum. Following operation a left-sided motor paralysis was found. The fashion of recovery again followed the motor pattern of the rolandic strip, beginning in the fingers and hand, and spreading in sequence to the elbow, shoulder and down the leg. The foot improved last.

Two cases with hemiplegia were recently described by Symonds[12] in which the major paralysis first occurred in the lower extremity. These were two of five cases presented as examples of cerebral thrombophlebitis. The first of the two cases was characterized by paralysis of the foot, weakness of the knee and hip, and slight weakness of the left upper limb. The patient recovered. Symonds made the following comment: "The distribution of the paralysis, leg affected severely, arm slightly, and face not at all, is what might be expected when thrombosis spreads from the superior longitudinal sinus into a tributary vein." The second case occurred in a woman who presented six transient attacks of weakness of the right lower limb followed the next day by a slowly developing paralysis of the right side, beginning first in the foot, and later involving the upper limb. Convulsions occurred and five days later temporary right-sided weakness developed. The patient ultimately recovered. The following comment was made: "The lower limb was first affected—a right hemiparesis spared the face, palate, tongue and speech."

Recently Merwarth and Gold[13] reported an unconfirmed case in which were found all the clinical findings noted in the earlier cited cases. Three additional cases are presented in which following the surgical removal of a parasagittal tumor, the syndrome of a venous hemiplegia developed:

Case IV. L. M., a thirty-six-year old female, was admitted to the Long Island College Hospital August 17, 1936, with the following story: Ten weeks previously she was awakened at night by jerking movements first noticed in the toes of the left foot which turned down. This was promptly followed by an involuntary straightening out of the left lower extremity, and an extension of the jerking movements throughout the left side of the body to the left upper extremity and the left side of the face. There was no loss of consciousness in the attack but she complained of an agonizing pain throughout the left side. This fit lasted fifteen minutes. The spells recurred frequently but the later attacks, although they still occurred nightly, involved only the left lower extremity.

Six weeks before admission the fit, which began as usual in the left foot, was followed for the first time by loss of consciousness. Just prior to losing consciousness, her face felt drawn to the left and she noticed buzzing in the left ear. On recovering from this unconscious spell she complained, again for the first time, of a headache over the top of her head. Since then daily headaches occurred up to one week prior to admission when there was a second severe convulsive attack with loss of consciousness, following which she appeared dazed, and complained of a feeling of heaviness and weight on the left side and numbness in the left foot.

The neural examination showed the following positive findings: There was an ataxia in the finger to nose and heel to knee tests on the left;

an increase of the deep reflexes in the left lower extremity with an extensor toe sign of Babinski, and poor postural sense in the left great toe. Early choking of the optic discs was observed.

Fig. 1. Case 1. Lateral view showing location of area of calcification.

On August 18, an *x*-ray examination of the skull revealed the following: "In the right upper mid parietal region there is a moderately large, irregular calcific opacity measuring 2 × 2 cm., definitely within the brain substance particularly subcranial." (Fig. 1.)

Operation on September 4. "Upon opening the dura which presented no unusual findings, a parasagittal parietally situated tumor was disclosed. The tumor appeared to be a meningioma although it was quite soft on its periphery. It was not attached to the brain but had made a nest in the brain by external pressure. It was attached to the dura but did not implicate the longitudinal sinus. The rolandic vein traversed the thickened arachnoid across the most anterior except of the dura, at which point it was moderately constricted. After removal of the tumor the small dural attachment was cauterized with the coagulating current. An attempt was made to spare the entrance of the rolandic vein during this procedure. Complete hemostasis was accomplished." (Fig. 2.)

On the day following the operation, there was paralysis of the left side. She was not in shock and spoke intelligently. On September 7, she was mentally alert. There was no impairment of speech. On the left the deep reflexes were more active, and pathological superficial reflexes were obtained. Hypotonia of the muscles on the left was observed. There was a definite ability to grasp with the fingers of the left hand in distinct contrast to the poor muscle power found throughout the remainder of the muscle groups on the left side.

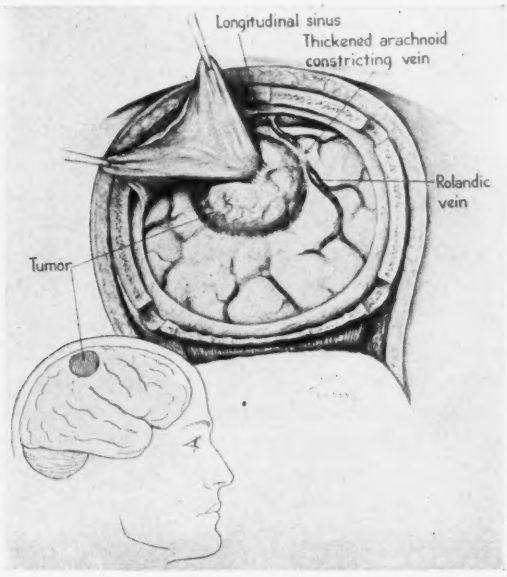

Fig. 2. Case 1. Relation of tumor and veins.

On September 10, a slight return of motion to the left upper extremity was observed. But on the following day the previously observed motions of the left upper extremity had disappeared. By September 13, movements had returned again to the left arm and fingers, and for the first time she was able to move the left leg. On September 16, very little residual paralysis on the left was noticed and four days later both upper extremities were moved without difficulty. By September 27, she was up and about the ward entirely free of complaints.

Comment. Although this patient presented a left hemiplegia immediately following the operation, she was alert. There was an initial return of function first in the fingers of the left hand, followed soon after in the elbow and shoulder.

There was a fluctuation in the return of function as shown by the disappearance of motor power in the entire upper limb for a brief period followed by a later complete return of power. The lower limb was the last to recover. There was no facial paralysis. The tone of the musculature was reported as hypotonic. The removal of the tumor presented no particular surgical difficulties except for the efforts made to

spare the rolandic vein skirting the anterior margin of the tumor.

The extent of the paralysis and the nature of recovery are quite characteristic of a venous hemiplegia. It seems logical that there was temporary interference with the drainage of the rolandic vein.

Case v. H. O., a female, age fifty-one, was admitted to the Neurological Unit of The Brooklyn Hospital on April 8, 1940. Her general health was excellent up to two years previous when a convulsive spasm occurred in the left lower extremity. The left leg first felt tight and painful, and in a few minutes repeated jerking movements occurred lasting fifteen minutes. After this attack the entire left lower extremity became numb and remained completely paralyzed for one-half hour, slowly returning to a normal state one hour later. Six months later a second attack was experienced, and since then the convulsive attacks have gradually increased in frequency averaging three daily for the past two months.

During the past twelve months the patient complained of a constricting feeling about the temples. Very recently a weakness of the left leg in walking was noticed. Following diagnostic encephalographic air studies performed six weeks ago she was confined to bed. A depression of the body of the right lateral ventricle in the second and third portions, without a shift of the ventricular system, was found in the encephalogram.

Physical examination revealed the patient to be jolly, alert and oriented. There was mild bilateral papilledema of the optic fundi. No facial paralysis or weakness of the left upper extremity was found. Downward drifting of the extended left lower extremity and terminal tremor of the left hand in the finger to nose test was found. In all other neural tests the physical examination was normal.

On April 10, an operation was performed. A firm encapsulated tumor was found the size of a lime at the motor strip, along the longitudinal sinus, extending about 3 cm. along the convexity of the hemisphere. A large vein in intimate contact with the tumor and emptying into the sagittal sinus was divided in order to remove the tumor. Just posterior to the tumor a large vein, three times the size of the preceding vein was seen. The tumor possessed a rich parasitic vascular supply and was easily stripped from its bed in the cortex, which showed little tendency to expand following removal of the tumor.

That same day at 11 P.M., a mild weakness of the left shoulder, elbow, left ankle and toes was noted. There was no facial paralysis. The left knee and ankle jerks were increased. Babinski's toe sign was obtained on the left.

On April 11, she was well oriented and alert. In the left hand the grip was good but skilled acts were impaired. The movements of the left elbow and shoulder were weak. The motions at the left hip and knee were performed weakly. There was no movement at the left ankle or toes. Appreciation of movement of the toes and fingers on the left side was grossly impaired, but that of pin prick was undisturbed.

On April 14, the patient was alert and cheerful. However, the entire left side was weaker. There was no motion of the left hand, foot or toes. All tests of sensation were normal. The following day the left grip was excellent and the left hand moved well. The left arm could be raised. No motion took place at the left ankle or toes. There was no increase of muscle tone.

The patient felt fine on April 17. A pillow could be moved with the left arm. The left foot could be pressed down but not up. On April 23, power throughout the left side was good save in the left ankle and toes, where only slight plantar flexion could be done. Skilled acts were not performed as well with the left as the right hand. The tone of the muscles on the left was not increased.

Eight days later, May 1, the physical examination was normal except for slight awkwardness in tests of skilled movements in the left upper extremity, and absence of movement about the left ankle save for slight plantar flexion.

Comment. Preoperatively there was found a minimum of abnormal physical findings, just a slight weakness of the left lower extremity and a slight awkwardness in the left hand.

At operation, the tumor was removed without difficulty. The vein intimately incorporated with the tumor was not cauterized but deliberately ligated. There was no use of electrocauterization except at the sinus edge of the tumor, where the adjacent dural margin was thoroughly cauterized. There was no disturbance with

the cerebral arterial circulation except for a minute arterial twig on the mesial aspect of the hemisphere. The surgeon, aware of

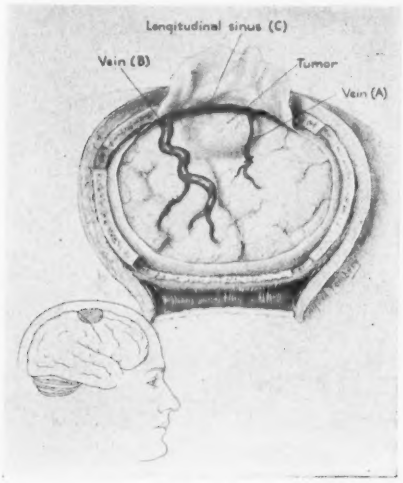

Fig. 3. Case 11. Condition of veins noted at time of operation.

the possibility of a subsequent venous stasis, deliberately tried to avoid its production.

Nevertheless, at 11 P.M., the day of operation, the patient showed a paresis of the left side with sparing of the left hand and face.

Prior to discharge the patient recovered entirely except for movements in the foot, which evidences slight weakness prior to operation.

The severe paralysis of the foot may have been caused by the occlusion of vein draining the mesial aspect of the hemisphere as the alleged anatomic location of the foot is said to dip over into the superior mesial aspect of the hemisphere.

Case vi. C. M., a colored male, of forty years, a former professional boxer was admitted to the Kings County Hospital, on September 8, 1940, because of convulsive episodes and a left-sided weakness. The past history was of no importance except for an injury to his head in 1928, at which time he was held up and severely slugged on the head. He was badly stunned but did not lose consciousness. At one time he received a series of injections in the arm for reasons unknown to him. In 1934, he first became aware of a "lump" in the midline of his head.

In 1937, he had had his first convulsion, the attack beginning in the left foot and then spreading to the left arm with his head turned to the left. There was no loss of consciousness

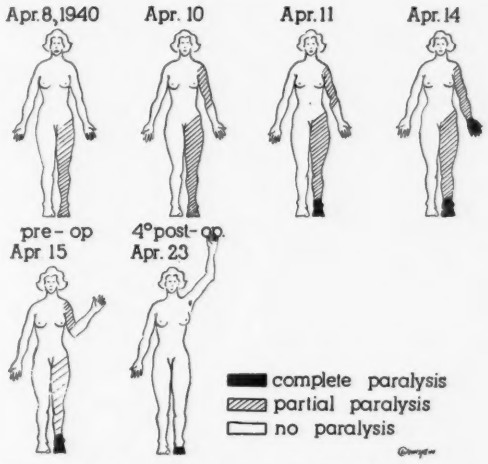

Fig. 4. Case 11. Showing progress of recovery.

for the attack happend at night and wakened him. In the beginning the attacks occurred about once every two months, gradually increased in frequency so that he required care in many hospitals. On July 4, 1938, after an attack, the left side remained paralyzed for four days and then gradually improved but always remained somewhat weak thereafter.

The physical examination on admission was as follows: The patient was mentally clear but somewhat unstable emotionally. His speech was slow and deliberate. He was right-handed. There was a dome-shaped bony prominence (7 cm. in length) in the anterior right parietal region. The optic discs were flat. There was a definite but slight, left hemiparesis most marked in the left lower extremity especially in the foot which dragged in walking; a lessened arm swing to the left extremity; slight clumsiness in the left hand, and a left facial flattening.

Conclusive evidence was found in the *x*-ray examination of a hyperostosing meningioma. (Fig. 5.) On October 8, 1940, an operation was performed, and a large tumor was found at least 6 cm. in length involving the longitudinal sinus and extending on both sides of the sinus, one-fourth of the amount on the left and three-fourths on the right. The tumor derived its greatest blood supply from the falx and the sagittal sinus, the large surface vessels being displaced. To remove the tumor complete resection of the superior sagittal sinus invaded by the tumor was done both anterior and posterior to the growth. (Fig. 6.)

Postoperative Course. On October 9, at 9 A.M. the patient was readily aroused and answered questions. No demonstrable aphasic disorders were esent. There was a complete paralysis of the left upper and both lower extremities. Both knee jerks were obtained. Pin prick seemed to be well appreciated. At 5 P.M. the grip was present in the left hand. The biceps jerks were brisk. Movements of the toes were not appreciated in the left foot. At 9 P.M. the whole left upper extremity was not flaccid and paralyzed. A grasp reflex was found in the right hand.

Fig. 5. Case III. *X*-ray showing area of hyperostosis in the midline of vertex.

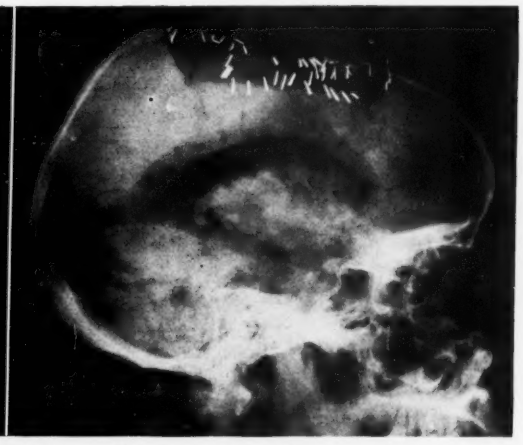

Fig. 6. *X*-ray to show the amount of sinus removed. The most anteriorly and posteriorly placed clips indicate the segment of sagittal sinus resected.

October 11, at 11:45 there were distinct, free, strong finger movements of the left hand with total absence of movement at the left elbow and shoulder. Plastic hypertonicity was found throughout the left upper extremity, considerable force being required to move the arm at the elbow. The movements of the left fingers were well appreciated. The deep reflexes were hyperactive, the left more so, in the lower extremities. At 12 o'clock, fifteen minutes later, the above movements noted in the left fingers had disappeared. This striking variation from return of finger movements to paralysis had been observed on four previous occasions. The patient became aware of the interest in the progress of the return of function and informed us of any change.

On October 14, movement at the elbow was first observed and the finger movements were present more constantly.

The following day slight movements were present at the left shoulder, the patient being able to raise the left upper extremity. The left grip was excellent. At the elbow the movements were stronger although fluctuations in power still were observed. The nurse noticed movements at the right thigh for the first time. By October 23, there was complete recovery in the left upper extremity and definite flexion of the left thigh.

On November 6, strong movements were present in the right thigh and slight movement at the right knee. By November 9, increased power at the right hip and knee and slight movement of flexion at the left hip. The patient became aware of a change before any perceptible movement occurred as the dead or numb sensation disappeared, for he remarked that he had a "return of feeling" in the right lower extremity before he could move it and now was beginning to have feeling at the left hip.

The nurse in charge observed the same ebb and flow in the return of motor power at the hip as was noted in the left fingers.

On December 11, there was free movement of the right lower extremity except at the ankle, and also at the left hip. Slight movement was observed at the left knee. Because of a continuing drain of serous discharge from the anterior margin of the flap the inserted protective rubber drain was removed. The underlying cortex was found covered with a heavy, creamy white exudate.

On December 15, the patient was able to stand although no movements at the ankles were possible. He was bright and alert.

On January 6, 1941, encephalographic air studies were performed which showed normal

position of the ventricles. The general condition of the patient was fair. There were 750 cells in the cerebrospinal fluid. The patient died on January 15, of bronchopneumonia.

Postmortem Examination—Gross Examination. The brain was removed with the dural membranes intact. Over the area of brain previously covered by the protective rubber drain there was a mucinoid exudate, judged to be reactive.

On reflecting the dura forward (Fig. 10) a small area of underlying cortex pulled away with it (shown as a light island about the center of the reflected dura). The previously depressed cortex, formerly the nest of the dura, had expanded to form a fairly even surface. The sinus both anterior and posterior to the resected segment was found patent. (Sections were removed for microscopic analysis.)

The cerebral veins on the superior aspect of both hemispheres were not distended. There were no gross superficial hemorrhages observed over the cortex.

Coronnal sections (1 cm. in thickness) showed mild ventricular dilatation. On the right the superior portion of the ventricle was pulled by apparent cortical shrinking occurring about 1½ cm. from the middle cerebral fissure. The cortex on the right and slightly on the left at a point corresponding to the left-foot area (motor and sensory) showed small areas of necrosis. The remainder of the cortex corresponding to the upper limb and face was normal.

Sections of the sinus removed for microscopic examination were entirely normal.

Comment. The failure of the recovery of movements in the lower limbs, the foot movements on the right, and knee and foot movements on the left, at least up to the time of death, is perhaps explained by the gross changes observed in the cortex.

The paralysis was immediate and fully developed at the time the patient was first observed shortly after the operation. Because of experiences obtained in other cases in which there had been interference with rolandic venous drainage, unusually careful scrutiny was applied to this patient.

The degree of paralysis, two lower limbs and the left upper limb, resembles the severe palsies noted in acute injury to the sagittal sinus. The pattern of motor recovery parallels the fashion observed in the hemiplegic cases. It was in this patient that

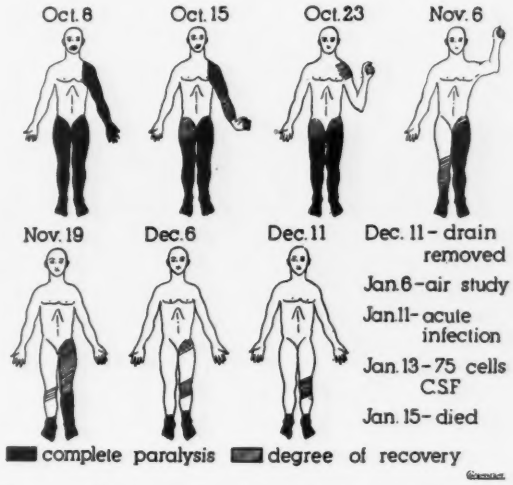

Fig. 7. Case III. Showing the pattern of motor recovery.

the tendency to variation in motor power stood out prominently, particularly in the left upper limb, finger movements being found at one examination and one-half hour later seen to be absent. Also the fluctuation in the state of muscle tone was conspicuous, being flaccid at one observation and extremely spastic at another. This feature was especially marked in the arms but was not so obvious in the lower limbs. It is noteworthy that urinary control was present immediately following the operation. The mental state was clear except for the last two days, preceding his unfortunate death from pneumonia.

DISCUSSION

As previously stated the modern concept of the total picture resulting from interference with the drainage of the superior cerebral veins dates from the aforementioned publication of Holmes and Sargent.[2] Unfortunately, their work is quoted only when references are made to abnormal states (trauma and inflammation) involving the superior longitudinal sinus itself. These authors state unequivocally that the clinical manifestations are caused by changes in the cortical veins, although the basic primary damage in many cases was

to the sagittal sinus in the neighborhood of the parietal lacunae, the point of entrance of the rolandic vein. This paper is so

Fig. 8. Case III. Showing the practically completely occluded sinus (arrows point to sinus).

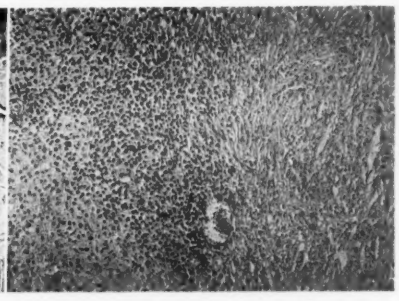

Fig. 9. Case III. Showing the organization within the sinus.

significant that a complete transcription of a typical case reported by them is in order:

Case VII. Private J. H. was wounded by a bullet on December 1, 1914. He became unconscious at once, and was unable, on admission to the base hospital two days later, to give any accurate information about himself. He was dull and apathetic but answered questions quite readily.

There were two separate penetrating wounds, 4 cm. apart, and equidistant from the midline, about 17 cm. behind the nasion—that is, slightly behind the midpoint. The entrance was on the left and the exit on the right, slightly larger and slightly anterior to it; the skull between them was comminuted.

His speech and the functions of all his cranial nerves were unaffected, but the retinal veins were swollen and the inner margins of the optic discs were blurred and indistinct.

His arms lay adducted to his side, flexed and pronated at the elbows, and were very rigid at the shoulders and elbows, but only slightly so at the wrist and in the fingers. He was unable to perform any voluntary movement with the right, but could flex and extend the left fingers feebly. The abdominal muscles were rigidly contracted and respiration was mainly thoracic.

Both lower limbs were very rigid and fully extended at hips, knees, and ankles, and rotated inward and adducted at the hips, so that the patellae came in contact with one another; owing to their position and their extreme rigidity they resembled strongly the lower limbs of a severe case of Little's disease. This extensor rigidity was not constant, as occasionally the limbs were found rigid in flexion, but as a rule it was so great that the limbs could not be passively flexed or separated from one another by any reasonable force. The knee and ankle jerks were much exaggerated and the hamstring jerks were present and brisk; the flexor jerks in the arms were also exaggerated, but the triceps jerks were feeble; both plantar responses were extensor and the abdominal reflexes were absent. When admitted his mental state was too dull to permit a proper examination of sensation.

Three days later he had a prolonged left-sided Jacksonian fit which commenced in the face. Ten days after receiving the wound he showed definite signs of improvement; his lower limbs were still completely paralysed and extremely rigid, fully extended, adducted and rotated inward, but he was now able to move his fingers freely, and perform feeble movements at the elbows; his shoulders were, however, still rigid and their movements paralysed.

Twelve days later all movements of the upper limbs were possible, but the proximal muscles, especially of the right, were very feeble and all efforts he made were very ataxic; both arms were still rigid at the shoulders and the right at the elbow, and constantly lay closely adducted to the sides and flexed.

The legs, too, remained extremely rigid, extended, adducted, and rotated inward, but he occasionally had strong flexor spasms in them, especially when turned on his side. No definite voluntary movement of either was possible, and any effort only resulted in a general contraction of all their muscles, and a slow vigorous extension if any segment of the limbs were flexed. Stimulation of either sole produced a vigorous withdrawal movement of the limb without any contralateral effect.

All the tendon jerks were greatly exaggerated, the plantar responses were of the Babinski

type, and the abdominal reflexes were abolished.

The examination of sensation revealed, especially on the right side, the disturbances found in pure cortical lesions when the stage of shock or diaschisis has passed; the lightest touches could be appreciated normally, but a certain percentage of purely tactile contacts failed to evoke a response, and this failure bore no definite relation to the intensity of the stimulus. Localization of touch stimuli was, however, not seriously disturbed. There was no diminution to painful stimuli, and no definite subjective difference in pinpricks between normal and possibly affected parts. The appreciation of position and of passive movement was almost completely lost in both lower limbs and in the right arm, but was little affected in the left arm; and corresponding thereto the discrimination of Weber's compass points was much disturbed in the legs and in the right arm; the two points could be distinguished 1 cm. apart on the left palm, while on the right they could not be recognized at double this distance, or on the soles when separated to 10 cm.

During the time he remained in the base hospital he had slight difficulty in passing urine, and occasionally incontinence; this he explained as due to the fact that he could "only hold his water for five minutes or so," and that it then passed involuntarily if he did not receive a urinal.

He was evacuated to England five weeks after receiving the wound, and had gradually improved during this time. His subsequent history is not known at present.

ANATOMY

The syndrome under discussion is concerned with the venous drainage on the lateral superior surface of the hemisphere, chiefly the veins emptying into the parietal lacuna, the rolandic veins. Since the complete picture is dependent upon the unusual characteristic of the physical set up of the somatic representation in the rolandic motor strip and the mode of drainage, a brief consideration of the pertinent anatomy is warranted.

The superior longitudinal or sagittal sinus is roughly short of a foot in length, and commences at the foramen cecum through which it receives a vein from the nasal cavity. It runs from before backward in an arching fashion to the torcular Herophili where the main channel deviates to one side, usually the right, and is continued as the lateral sinus. On its inner surface are the openings of the superior cerebral veins. Into this sinus empty the superior cerebral veins, which, while not following a strictly constant pattern, usually unite into four principal trunks: (1) frontal (2) precentral, (3) postcentral or rolandic and (4) an occipital. Of these the postcentral or rolandic vein is usually the largest and as it drains the pre- and postcentral gyri are the most important. On the mesial aspect of the hemisphere are corresponding veins which empty into the sagittal sinus approximately at the same point as the neighboring veins on the lateral hemispheral surface. The veins empty into the sinus at a gradually increasing obliquity, the foremost group at right angles while the posterior group enters at a sharp forwardly directed angle. Over the occipital lobe there may be no veins entering the sinus.

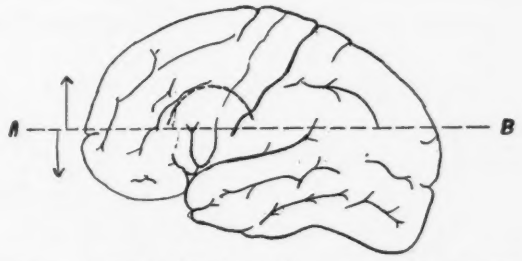

Fig. 10. Rough sketch to show approximate area of external brain surface drainage by the superior cerebral veins above line A-B, and the sylvian system below line A-B. Arrows indicate direction of venous current in relation to line A-B, drawn through tip of sylvian fissure.

The lower half of the lateral surface of each cerebral hemisphere is drained by the sylvian vein, which drains the face, hand area, as well as the temporal lobe, and empties into the cavernous sinus. An important anastomotic connection unites the superior and inferior groups, the so-called anastomotic vein of Trolard. In addition a further anastomotic reserve is found in the vein of Labbe which unites the sylvian vein

with the superior petrosal sinus at the point where it joins the lateral sinus.

An important anatomic variation in the cerebral veins as contrasted with the systemic veins is the complete absence of valves which readily permit the rapid shunting of blood.

The cerebral veins are fine, soft, easily compressible and enter directly into the hard, thick, resistant dural sinuses.

There exists a vast anatomosis between all of the veins in the superior cerebral surface, forming a great network over the cortical surface.

The flow in the systems is in opposing directions. In the erect posture the flow in the superior cerebral veins is upward to the sagittal sinus, while in the inferior group it is downward toward the cavernous sinus. Because of their anatomic position the flow in the posterior groups of superior cerebral veins is against the current in the sagittal sinus which normally flows backward to the torcular Herophili.

The veins draining the rolandic area, both the pre- and postrolandic terrain, are the particular veins under consideration in this presentation. It is the interference with the circulation in these veins which produces the characteristic syndrome. According to Holmes and Sargent, the area on both sides of the rolandic fissure, above a horizontal line drawn through the tip of the sylvian fissure represents the drainage area of the rolandic veins.

The parts drained from above along the interhemispheral fissure down to the sylvian fissure follow the classical representation of the cellular pattern in the rolandic strip. According to this concept the motor areas representing the face, tongue and speech are spared. Also the motor area representing the hand may be spared or slightly involved.

The pressure in the cerebral venous system is low, the flow being largely maintained by arterial pulsations. The current is easily influenced by such normal activities as coughing, sneezing, straining at lifting or at stool. Ordinarily, these acts are without harmful effect because the absence of valves in the veins favors a reversal of flow of the sluggish venous currents. Because of the naturally elaborate interlinking, the tendency to reversibility is protective in that minor checks of the normal flow in one area are readily compensated for by the ease with which the flow is directed elsewhere.

The elaborate anastomotic capacity, the absence of valves, the easy reversibility of current flow, serve to function as a great absorbing sponge when required. On the other hand, the angle at which the posteriorly placed superior cerebral veins enter the sinus, the flow in them being opposed to the current in the sinus, the fine, small caliber of the veins, the low venous pressure leading to easy compressibility are conducive to the production of serious changes once a noxious agent is introduced.

The freedom of anastomosis undoubtedly serves as a sponge to counteract a block at any point in the system. The efficacy of the well knitted collateral circulation determines the response to an occlusion. An interference with drainage in the superior veins, as they are about to enter the sagittal sinus, is immediately reflected in the surrounding web-like venous channels, which if adequate, as is probably very often the case, may result in an asymptomatic occlusion. When a stasis occurs, it is reflected by a damming up into the most minute venous pathways. The cortical gray matter and underlying white matter are affected. The function of the cortical cells is disturbed, producing both prerolandic and postrolandic signs and symptoms.

Temporarily, there may be an overflow into the sylvian system affecting the hand, accounting for an early paralysis of the hand, which rapidly recovers its functions as soon as the sylvian system can carry the extra burden. The functions of the elbow, shoulder, trunk, hip, arm and leg are lost, recovering in this order. The essentially gnostic sensory disturbances which are found are attributed to the same interference with venous flow in the cerebral veins.

PATHOLOGY

The pathological changes observed in fatal cases have been well described by Holmes and Sargent:[2] "When the dura mater was removed the most striking feature was the condition of those superficial cortical veins which enter the sinus at the position of the wound; these were swollen, firm to touch, and could not be emptied by pressure, and there frequently seemed to be congestion of the neighbouring veins which were not actually thrombosed. The superior parts of the hemispheres which were drained by these veins were usually swollen and their convolutions flattened by pressure against the inner surface of the skull, and generally firm to the touch. On section there was obviously much oedema of the cortex and subcortical white matter, and minute hemorrhages, which were grouped more closely in the neighbourhood of the wound, were found. In a few instances there was an actual softening near the mesial fissure, the disintegrated brain matter being blood-stained, and punctiform hemorrhages were found in the cerebral tissue around it."

Evidence of previous bleeding or fresh bleeding in the cerebrospinal fluid is not an unusual finding in proved acute interruption of the venous circulation in the longitudinal sinus or in its tributary veins. Holmes and Sargent noted that "In a few of the cases which came to postmortem examination and in others in which the condition could be observed during operation, there were widespread subdural hemorrhages, which usually formed a thin layer of blood over the convexity, and sometimes extended to the base of the same hemisphere; in other cases cerebrospinal fluid removed by lumbar puncture was either blood-stained or straw-coloured." Dusch[4] (1861) quoted a case of thrombosis of the longitudinal sinus which at autopsy revealed changes in the sinus, and reported that "the whole of the pia mater on the surface of the brain and between its convolutions is replete with blood, and in some places, especially on the right sylvian fissure, more considerable extravasations exist." Irish[14] (1938) likewise noted extensive subarachnoid bleeding in one instance of cerebral venous thrombosis. Large subarachnoid hemorrhages and hemorrhagic foci of necrosis in the cerebrum were almost invariably accompanied by thrombosed veins in the observations of Byers and Hass[15] (1933).

SURGICAL SECTION OF THE SAGITTAL SINUS

In surgery the question arises as to the advisability of resecting a segment of the sinus whenever it is directly involved by tumor, such as the meningiomas which are prone to recur unless the primary focus is completely removed. While it is true that sudden obstruction of the circulation within a previously unoccluded sinus provokes serious sequelae, changes of equally severe degree result from accidental trauma to the rolandic vein alone. Unfortunately, all previous emphasis has been on damage to the sinus, the important tributary veins having been seemingly ignored. Surgeons have long been aware of the danger in tampering with a patent sinus, so much so that there are few recorded accounts of deliberate sinus resection. In the available reports there is little mention of the state of the tributary veins or the number of veins ligated, except for the descriptions noted in Dandy's recent paper. Apparently, the first reported planned attack on the sinus occurred in 1911 when Kenyon[16] placed ligatures about the sinus 2½ inches apart. The entire problem of the attack on the sinus was considered in detail by Cushing,[17] Adson,[18] and more recently by Dandy.[19]

The writer has been able to collect a total of thirty-one cases (Table 1) from the literature and from personal communications received from neurosurgeons. Where the sinus was removed anterior to the rolandic point (seventeen cases) there were six cases in which no postoperative disability was noted (Dandy's two cases, and one each of Adson and Sheldon,[20] Grant,[21] Vincent,[22]

TABLE I

No.	Year	Surgeon	Reason for Resection	Location	Amount of Sinus Resection	Operation	Immediate Sequelae	End Result	Condition of Resected Sinus
1	1911	Kenyon (Rep 1915)	Parasagittal meningioma	Anterior ⅓	Ligatures 2½ inches apart	Ligation			
2	1922	Rand	Parasagittal meningioma	Anterior ⅓	10 cm.	Second op. section	None	Lived 18 years	
3	1923	Horsley quoted by Penfield	Bilateral—parasagittal meningioma	Frontal	.....	At second operation	Died		
4	1923	Towne	Hyperosting meningioma	Anterior ⅓	8 cm.	.....	None	Died 2 months	
5	1928	Grant (Rep 1933)	Bilateral—hyperosting meningioma	Frontal	4 cm.	.....	None	Recurrence	Sinus occluded
6	1933	Ira Cohen	Bilateral meningioma	Occipito-parietal	5 cm. beginning 2.5 cm. above torcula.	First operation section of sinus; removal of tumor	Died same day	.....	Sinus occluded
7	1934	Vincent reported by David et al	Parasagittal meningioma	Anterior to rolandic veins	5 to 6 cm.	Tumor and sinus	None	Recurrence	Sinus occluded
8	1935	Tonnis	Meningioma	Torcular region	.....	Removal of postsag sinus, lateral sinus and tent.	None	Recurrence; homonymous hemianopia	
9	1937	Davidoff	Bilateral—hyperosting meningioma	Extensive mid- and posterior portion of sinus	.....	.....	Mild hemiplegia	Recurrence	Sinus occluded
10	1938	Adson	Parasagittal meningioma	Anterior to Rolandic veins	.....	Removal of tumor, section of sinus	None	Recurrence	Not determined
11	1939	Rowe	Parasagittal meningioma	Mid- and posterior portions	Extensive amount not mentioned	First operation; removal of tumor section sinus	None	Recurrence	Not determined
12	1939	Horrax Maltby	Parasagittal meningioma	Mid- and posterior portions	5 cm.	First operation tumor and sinus	Left hemiplegia	Recurrence	Occluded
13	1939	Horrax Maltby	Parasagittal meningioma	Pariet-occipital	6 cm.	First operation tumor and sinus	Left hemiplegia	Recurrence	Occluded
14	1928	Dandy	Parasagittal meningioma	Frontal	8 cm. removed 4 cm. ant. to rolandic V	Third operation sinus removed	None	Died 3 mo. of recurrences	Occluded
15	1936	Dandy	Bilateral parasagittal meningioma	Frontal	8 cm.	First operation	Uneventful	Well (3-10-40) Recurrence	Occluded
16	1939	Dandy	Left parasagittal meningioma	Mid- and posterior portions	10 cm.	Second operation	Paraplegia	Recurrence	Occluded
17	1940	Dandy	Bilateral—parasagittal meningioma	Mid- and posterior portions	6.5 cm. extending backward	Third operation	None	Recurrence	Not determined
18	1937	Browder	Parasagittal meningioma	Anterior ⅓	.....	First operation	Hemiplegia	Left hem	Occluded
19	1940	Browder	Parasagittal meningioma	Anterior ⅓	.....	First operation	Hemiplegia	Recurrence	Occluded
20	1940	Browder (case III in paper)	Bilateral—parasagittal meningioma	Mid- and posterior portions	10 cm.	Resection first operation	Crural paraplegia and left arm	Recurrence except for left foot; died of pneumonia	Occluded
21	1940	Kaplan	Olfactory groove meningioma	Anterior ⅓	.....	First operation	?	Recurrence	Not occluded
22	....	J. King	Metastatic carcinoma frontal pole	Extreme anterior portion	4 cm.	Resection	None		
23	....	J. King	Parasagittal meningioma	Premotor area	4 cm.	Ligation of sinus to control bleeding	Left arm bad ? cause ? Brain tumor		
24	....	J. King	Parasagittal meningioma	Anterior to rolandic vein	?	Resection	Motor weakness following operation	.....	Not determined

TABLE II
CUSHING'S SERIES

No.	Year	Type Tumor	Location and Amount Resected	Operation	Postoperative Complications	End Result
1	1913	Hyperosting 503-4	5 cm. right parieto-occipital	Attempted removal en bloc tumor, falx and sinus, 5 cm. sinus involved	Died	Died from ersanquination
2	1924	Hyperosting 503-6 Bilateral	Frontal ⅓	Radical incomplete removal tumor, falx, and sinus	Rhinorrhea	18 months
3	1925	Nonparasagittal 455-29	5 cm. ? central ⅓	Fourth operation recurrence sinus, tumor and falx	Increase of hemiplegia; gradual recovery	1935—5th (Horrax) wheel chair; crural paraplegia
4	1927	Hyperosting 504-8	6 cm. paracentral	Partial removal of growth and sinus	Diplegia	Died three years; diplegia
5	1929	Bilateral 460-41	Frontal ⅓	Extirpation of bilateral tumor with cyst, sinus and falx	.....	Died 1 mo. postoperatively; thrombosis femoral
6	1931	Bilateral 441-46 452	6 cm. central ⅓	Recurrence excision bone, sinus and falx	Diplegia; slow recovery	Self supporting 1937
7	1935	505-11 Horrax	8 cm. up to rolandic veins	Recurrence of tumor and sinus	None	Good recovery 10 years

and Rand.[23] Portions of the sinus at or posterior to the rolandic point were removed by Tonnis,[24] Davidoff,[25] Rowe,[26] Maltby,[27] two cases, Dandy two cases, Browder* one case, Cushing four cases. Of the latter group there were three cases (Rowe, Tonnis and Dandy) in which no new postoperative symptoms occurred. Rowe's case was entirely free of physical signs at all stages. Dandy's Case III was remarkable because of amount of sinus resected, 10 cm. of the mid- and posterior portions, and the number of veins occluded. "Several veins entering the sinus from the hemispheres were thrombosed with the electrocautery and divided. These veins included the rolandic veins on both sides. About eight veins were thrombosed on the two sides; all of them were very tortuous."

A most astounding case was reported by Davidoff[25] in which at three carefully considered operative procedures one of the largest recorded occluding meningiomas was removed from the mid- and posterior parts of the sinus with a resulting temporary hemiplegia. In one of Maltby's cases, in which the sinus was removed at and posterior to the rolandic point, a postoperative hemiplegia occurred with ultimate recovery.

As far as could be determined from an analysis of Cushing's figures (Table II), he had occasion to resect the sinus in seven cases of tumorous invasion. The first occurred in 1913 when 5 cm. of the parieto-occipital portion of the sinus was resected with operative fatality. Three other deliberate resections in the area of the rolandic portion resulted in a recovered crural paraplegia in one case, a permanent crural paraplegia in a second, and a recovered hemiplegia in a third. Two frontal cases did poorly which is significant

* Personal communication.

in that this part of the sinus is mentioned as most favorable for attack. But one of the cases had no postoperative motor paralysis.

In all instances in which resection of the sinus was followed by recovery, a subsequent study of the resected sinus revealed complete occlusion. This suggests an occluding process acting over a long period of time, thus permitting the utilization of the profuse collateral circulation, already available. Dandy contends that "removal of a sinus, previously occluded by compression or direct invasion adds little or nothing to the demand for collateral venous circulation." However, this is true only if the established collateral circulation is sufficient for even when the sinus has been obstructed, unforeseen inadequate drainage patterns may still provoke disaster, as in Case IV in this report.

Cushing remarked that "when tumors involved the anterior third of the sinus a large section of it might be with safety excised along with the tumor mass." Even in this portion of the sinus handling is not unattended with danger, for two of Cushing's anteriorly placed cases did badly, and in Horsley's[28] case sepsis of the anterior portion of the sinus had eventually invaded a tributary cerebral vein with resulting hemorrhage into the brain tissue. Cushing believed that the after-effects of an acute surgical excision of the segment in the mid- and posterior portions would presumably be as serious as those produced by an acute thrombosis; and that the matter of dealing with an uninvolved sinus at the primary operation was still an open question. This question was debated when a patient had a parasagittal recurrence after fourteen years and following resection of 4 cm. of the sinus developed a permanent paraplegia.

The importance of the potential danger in suddenly interrupting the circulation in the posterior cerebral veins was also recognized by Elsberg[29] because of the possibility of inducing protracted plegias. In a personal communication, Stookey* observed that only when the sinus is occluded by tumor is it advisable to cut across the sinus. Neurosurgeons in general are unanimous concerning the dangers of cutting across a sinus not obstructed by a tumor either through compression or invasion.

Although the literature stresses the major emergent channel, the sagittal sinus, as the part to be treated carefully, precise consideration shows that it is the tributary cerebral veins which are of basic importance. In the reported cases of successful removal of a portion of the sagittal sinus behind its vulnerable site—the rolandic point—there ensued physical signs of varying severity with progressive recovery and in two instances no postoperative sequelae. Such favorable response indicates that a previous circulatory adaptation has been set up by means of the profuse venous anastomoses existing between the terminal cerebral veins and also their many interlocking tributaries. In such circumstances undoubtedly for a long period of time prior to operation the sinus could no longer have been used for the transmission of blood, which instead of flowing upward to the sagittal sinus, utilized the connections between the superior and inferior systems made possible by the anastomotic vein of Trolard. When physical symptoms occur after surgical interference with the sinus they are the result of the impact felt on the drainage area of the disturbed cerebral veins.

The conclusion may be drawn that occlusion of the sagittal sinus by tumor may be asymptomatic only provided the shutting off of the venous flow in the sinus is the result of a gradual occluding process acting over a long period of time, during which period other collateral venous channels are developed.

At the present time the possibility of determining whether satisfactory occlusion exists, or even so, whether there will or will not be unfortunate sequelae following removal of a portion of the sinus is totally unpredictable and is clearly in the lap of the gods. Dandy states "there is as yet no

* Personal communication.

available evidence by which it can be known whether the longitudinal sinus can be removed in part before gradually progressive occlusion has occurred."

SYMPTOMS AND SIGNS

The symptoms and findings as revealed in these patients resemble closely those described by Holmes and Sargent. However, we have found that one of the outstanding features of a venous hemiplegia is that of symptomatic fluctuation, which, though it may have been observed, is not mentioned in their report. This embraces both the motor and sensory fields. It is this variation in clinical manifestation of a venous hemiplegia, especially early in the course of its development, which necessitates frequent examinations for otherwise the rapidly shifting picture may be missed.

The responses of the patient in the higher fields of intellect are relatively unimpaired. Despite the usual shock attending a major surgical procedure, the patient is surprisingly alert on recovering from an anesthetic. There is complete comprehension and every effort is made to co-operate with the examiner. Also, when the patient is seen before an operative procedure, the appearance does not suggest sickness. (The syndrome was observed in one patient prior to operation.)

This picture is in marked contrast to that presented by a patient suffering from a hemiplegia on an arterial basis. Such a patient, if conscious, is apprehensive. There may be cold, clammy perspiration. Also considerable confusion, cloudiness of consciousness, disorientation and urinary incontinence may be present.

The disturbance of speech, both aphasic and dysarthric, usually found in arterial disorders is totally absent. In three of the cases herein presented, the patients were right-handed, and the hemiplegia occurred on the left side so a possible disturbance of speech can not be evaluated. However, in two of the patients, whose cases were previously presented[1] the hemiplegia was on the right side in right-handed individuals, and in neither case at any period either pre- or postoperatively was there a suggestion of aphasia. Holmes and Sargent observed this finding without exception in their large series. Such an observation is in great contrast to the common aphasic defects noted in the usual arterial lesions.

In the first two cases presented there was no facial paralysis noted before or after the operation. The third patient presented a left facial flattening prior to the operation but it was not increased by the surgical procedure even though there was a complete paralysis of the left upper and lower limbs. In arterial disease the facial paralysis is common, conspicious and persistent.

The type of paralysis found is characteristic. The lower limb, particularly the foot, is paralyzed to the greatest degree. In the upper limb it is the proximal joints which are weakened while the finger and hand movements are usually preserved and if involved soon recover. This is in distinct contrast to the capsular hemiplegia in which movements of the upper limb, especially the fingers and hand, are absent.

Early in the disease the tone of the musculature on the paralyzed side is unusually spastic. Also there is marked fluctuation in the state of tonus, which as mentioned in the comment in Case III, varied in the course of several examinations. An extreme degree of rigidity requiring force to move the limb may be noted at one examination and subsequently the limb may be hypotonic. Naturally, this phase of the illness may be missed completely if frequent examinations are not made. The quality of the tone is best described as plastic during the state of rigidity, the limb becoming freely movable as motion is maintained at the joint tested. Invariably the state of tone in the arterial hemiplegias is hypotonic, during the first twelve days, and it is only as the plegia persists that the hypertonic state is found. Furthermore, in arterial lesions there is a tendency to fixation at the joints, quite in contrast to the venous hemiplegia.

The reflex state shows the same fluctuations. The deep reflexes are hyperactive early, although if examined during the state of "nonrigidity" they may be diminished. In arterial hemiplegia the deep reflexes are invariably absent in the early stages.

The recovery of motor function is the second outstanding feature of a venous hemiplegia. The pattern of recovery follows the outlined motor representation in the rolandic area. As stressed, the hand and finger movements may remain unimpaired but if implicated are the first to recover. The picture of preserved function in the fingers and hand with absence of movement at the elbow, shoulder, and lower limb is striking and impressive. In the course of time function returns progressively to the elbow, shoulder and lower limb. The last function to recover, if at all, is that of foot and toe movements; and the same quality of fluctuation in recovery of motor function is manifested. In all three cases the fluctuation from use to nonuse was manifested but was very marked in Case III. In the course of an hour's observation the power returned, disappeared, and returned again to the movements of the left hand and fingers. The same fluctuation occurred at the elbow and shoulder and again in the lower limb. Similar variation from paralysis to use and again recurrence of weakness was noted in a postpartum hemiplegia with recovery in which the cause was never determined. In one of Symonds' cases of cerebral thrombophlebitis this ebb and flow of power occurred at least six times in twenty-four hours before the actual paralysis developed.

It is noteworthy that preceding the recovery of motor function the patient is conscious of an improved sensation in the paralyzed limb. In Case III the comments of the patient were emphatic. In Dandy's third case of sinus resection the remark is made "on the day before motor function began to return he noticed increased feeling in both legs."

How different is the fashion of recovery in an arterial hemiplegia. The paralysis is immediate and well established. The first function to return is that of the lower limb. Even when the patient becomes ambulatory, fairly complete paralysis of the upper limb may remain with an emphasis on the weakness of finger movements.

The sensory loss is chiefly in the gnostic field, postural appreciation, two-point test and object recognition. If pain sensibility is disturbed it is not marked. The recovery of gnostic sensory function does not parallel that of motor recovery, but remains somewhat delayed. In Case III in the presence of good motor power in the fingers there still was impairment of postural appreciation. The capacity to recognize objects, two-point test, and posture in the fingers returned shortly after the recovery of motor function was complete and constant. The tendency to variation is also observed in the sensory field, so that two successive examiners may record apparently contradictory findings. In one case as yet unproved, but in which the clinical findings were classical of a venous disturbance, the sensory examination was particularly difficult, no two examiners obtaining the same finding.

The disturbances of sensation in arterial disease are mainly those of pin prick appreciation while so-called cortical sensibilities may be preserved. There is no fluctuation; the pattern remains unchanged until recovery takes place.

PROGNOSIS

As observed in the cases studied, the general tendency is toward a complete recovery. In two cases previously reported and in the three cases in this paper, there was virtually no damage to the brain tissue itself during the operative procedure. As noted, there was no damage to an important arterial twig. All technical surgical steps took place high on the cerebral cortex immediately adjacent to the sagittal sinus. In but one case was there direct interference with this sinus, and this occurred in Case III, in which an extensive segment was removed. The immediate postoperative

Table III*

Arterial (Internal Capsule)	Venous (Superior Cortical Surface)
1. Soon established and complete.	May be transient, repeated attacks of weakness before paralysis is established.
2. The onset is usually precipitate.	Progressive onset.
3. Clinical picture of shock—pallor, cold, clammy skin.	Color good.
4. History obtained from others.	Able to give own story.
5. Often unconscious; cloudy sensorium.	Mentally alert.
6. Aphasic or dysarthric speech.	No disturbance of speech.
7. Marked supranuclear facial paralysis—protracted.	Transient or absent facial weakness.
8. Face, arm, particularly the hand, most paralyzed.	Lower limb involved most severely.
9. Flaccidity of paralyzed side ten to twelve days.	Immediate or early rigidity (plastic type).
10. Increase of tone during recovery (spastic) with return of function.	Fluctuation in tonal state; decrease in tone during recovery.
11. Early absence of deep reflexes; no early change.	Marked variation in the reflex state; early hyperactivity or absent reflexes.
12. Pain is modality of sensation most disturbed; all modalities may be lost; little variation.	Gnostic or cortical loss two-point muscle joint and tendon sense; pain may be undisturbed; variations day to day.
13. Recovery of muscle power usually occurs first in the lower limb, finger movements late or not at all.	Lower limb last to recover; finger movements recover first, then elbow and shoulder.
14. A steady progressive recovery.	Marked fluctuation in the motor power during recovery, shifting from complete paralysis to good function and back to paralysis in an hour's time.

* Represents the contrast in findings in a hemiplegia caused by arterial occlusion (capsular) and one induced by obstruction to the drainage of the rolandic veins.

findings were caused by temporary interference with the drainage of the important rolandic vein. It is debatable whether an actual thrombosis necessarily occurs, stasis itself being sufficient to provoke the picture. Recovery is dependent upon circulatory adjustment, possibly in the rolandic vein or through other venous anastomotic channels. According to Holmes and Sargent, if "the brain itself has not been at the same time damaged by the missile the symptoms due to obstruction of the venous circulation diminish gradually, and will eventually disappear, almost or entirely;—the degree and rate of improvement may depend as much on the inconstant anatomical arrangement of the veins and the amount of anastomosis between the two lateral venous systems as on the severity of the lesion."

CONCLUSIONS

A further elaboration of the syndrome of the rolandic vein is presented. Three additional cases are given in which the clinical manifestations follow the pattern previously observed in interference with the drainage of the rolandic vein.

These characteristics in the main are early rigidity, gnostic type of sensory disturbances, and a motor paralysis frequently sparing the face, with a fashion of recovery beginning first in the hand, the foot being the last to regain motor power.

Also the literature of deliberate surgical resection of the sagittal sinus has been surveyed. A tabular listing of the reported cases together with other personally communicated cases is added.

REFERENCES

1. Putnam, T. J. Discussion of paper: Clinical syndrome of occlusion of rolandic veins. *Arch. Neurol. & Psychiat.*, 44: 461, 1940.
2. Holmes, G. and Sargent, P. Injuries of the superior longitudinal sinus. *Brit. M. J.*, 2: 493, 1915.
3. Gowers, W. R. Diseases of the Nervous System. (Am. ed.) P. 834. Philadelphia, 1888. Blakiston.
4. Dusch, T. On Thrombosis of the Cerebral Sinuses, Selected Monographs. London, 1861. The New Syndenham Society.
5. Wimmer, A. Sinus thrombosis; a case simulating apoplexy. *Med. Wchnschr.*, November 12, 1906.
6. Lannois, M. L'hemiplegie ascendante dans la thrombophlebite du sinus longitudinal superieur. *Acta d'oto. laryng.*, 7: 199, 1924–1925.
7. Chalier, J. and Naussac, H. La thrombophlebite du sinus longitudinal superieur avec hemiplegie terminale, *Acta d'oto. laryng.*, 11: 1184–1931.
8. Davis, David, B. Thrombosis of a superior cerebral vein. *J. Nerv. & Ment. Dis.*, 77: 22, 1933.

9. Waggoner, R. W. Thrombosis of a superior cerebral vein, clinical and pathological study of a case. *Arch. Neurol. & Psychiat.*, 20: 580, 1928.
10. Dowman, C. E. Thrombosis of the rolandic vein. *Arch. Neurol. & Psychiat.*, 15: 110, 1926.
11. Merwarth, H. R. Hemiplegia of cortical or venous origin, (occlusion of rolandic veins). *Brooklyn Hosp. J.*, 2: 193, 1940.
12. Symonds, C. P. Cerebral thrombophlebitis. *Brit. M. J.*, p. 348, September, 1940.
13. Merwarth, H. R. and Gold, M. Hemiplegia of venous origin, case report. *Med. Times*, 69: 292, 1941.
14. Irish, C. W. Longitudinal sinus thrombosis. *Ann. Otol., Rhinol. & Laryngol.*, 47: 775, 1938.
15. Byers, R. K. and Hass, G. Thrombosis of dural venous sinuses in infancy and childhood. *Am. J. Dis. Child.*, 45: 1161, 1933.
16. Kenyon, J. H. Endothelioma of the brain; three years after operation. *Ann. Surg.*, 61: 106, 1915.
17. Cushing, H. and Eisenhart, L. Meningiomas. Springfield, Ill., 1938. Charles C. Thomas.
18. Adson, A. W. The surgical consideration of brain tumors. *Northwest. Univ. Bull.*, 335: 16, 1934.
19. Dandy, Walter. Removal of longitudinal sinus involved in tumors. *Arch. Surg.*, 41: 244, 1940.
20. Adson, A. W. and Sheldon, C. H. Intracranial meningiomas. *Proc. Staff. Meet., Mayo Clin.*, 13: 482, 1938.
21. Frazier, C. H. and Alpers, B. J. Meningeal fibroblastomas of the cerebrum. *Arch. Neurol. & Psychiat.*, 29: 935, 1933.
22. Vincent, C. (Cited by David, M., Bissery, M. and Brun, M.) Sur un cas de meningiome de la faux opere avec succes. Absence de troubles paralytiquest apres resection du sinus longitudinal au nivean de l'abouchement des veines rolandiques. *Rev. neurol.*, 1: 725, 1934.
23. Rand, C. W. Osteoma of the skull: report of two cases, one being associated with a large intracranial endothelioma. *Arch. Surg.*, 6: 573, 1923.
24. Tonnis, W. Die Zulassigheit der Resektion des Langs-blutleiters des Gehirns. *Deutsche Ztschr. f. Nervenh.*, 136: 186, 1935.
25. Davidoff, L. M. Meningioma: report of an unusual case. *Bull. Neurol. Inst. New York*, 6: 300, 1937.
26. Rowe, S. N. Parasagittal meningiomas. *Am. J. Surg.*, 43: 138, 1939.
27. Maltby, G. L. Resection of longitudinal sinus posterior to the rolandic area for complete removal of meningioma. *Arch. Neurol. & Psychiat.*, 42: 1135, 1939.
28. Horsley, V. (Quoted by Penfield, W.) Cranial and intracranial endotheliomata-hemicraniosis. *Surg., Gynec. & Obst.*, 36, 657–674, (343, 351, 498) 1923.
29. Elsberg, C. A. The parasagittal meningeal fibroblastomas. *Bull. Neurol. Inst. New York*, 1: 389, 1931.

THE MANAGEMENT OF MALIGNANT TUMORS IN THE GROIN*

A REPORT OF 122 GROIN DISSECTIONS

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INTRODUCTION

IN the course of study of a series of 400 malignant melanomas treated at the Memorial Hospital more than three years ago, the most interesting and rueful conclusions concerning treatment had to do with the previous management or mismanagement of melanoma metastatic to lymph-nodes in the groin. The extremely bad results were so shocking as to stimulate a more rational and radical plan of treatment which has been pursued now for more than three years. The purpose, therefore, of this article is to present the details of procedure as now employed and the end results, lamentably poor as they are, of 122 groin dissections performed during the past twelve years. Of these 122 groin dissections, forty-one were bilateral, sixty were for metastatic melanoma, fifty-five were for metastatic epidermoid carcinoma and seven were for primary sarcomas of the soft somatic tissues occurring in the groin.

As the radical procedure is of more recent adoption, the greater number of these dissections herein reported were of the superficial character and perhaps should be analyzed separately. The so-called radical dissection, which will be described in detail, has been done for current cases during the past three or four years so that long term comparative follow-up studies are not possible.

In addition to metastatic melanoma involving the groin it was decided to study the comparative behavior of epidermoid carcinomas, capable of metastasizing to the inguinal, femoral and iliac lymph-nodes. The sequence of events for malignant melanomas and epidermoid carcinomas of the lower extremity, for example, parallel each other in some respects but the time relationships and end results are divergent. The melanomas constitute the more interesting study because of the high incidence of nodal involvement and the necessity for radical surgical intervention. Of the 122 patients who had groin dissections and are the basis of this report, forty-four of sixty who had malignant melanomas and thirty-five of fifty-five who had epidermoid carcinomas, presented definite evidence of metastasis in groin nodes on admission. Under the indications for groin dissection subsequently listed, will be noted the advantages of elective dissection in the case of melanoma, even though no clinical evidence of metastasis to groin nodes are evident. The more conservative policy of waiting for proof of metastatic involvement of lymph-nodes in the groin by epidermoid carcinomas is generally followed. In our experience, for example, 24 per cent of patients with epidermoid carcinomas of the hands and feet and without palpable regional lymph-nodes, subsequently developed nodal metastases while under observation. If dissection of these regional lymph-nodes had been routinely done on admission, 75 per cent of them would have been unnecessary.

The value of groin dissection for metastatic cancer is generally admitted. No

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substitute such as radiation therapy has proved to be satisfactory. An operative mortality of less than 2 per cent is a small risk for the treatment of an otherwise lethal disease. The end results obtained fully justify the hazards of the operation. The frequency of local recurrence in the groin following the usual superficial dissection offers a strong argument for the more frequent employment of the radical operation, in which the dissection is carried above the inguinal ligament. Basset popularized the radical groin dissection, which has consequently been given the eponym of Basset's operation. Taussig improved this procedure by laying open the inguinal canal, ligating the deep epigastric vessels, removing the iliac lymph-nodes and occasionally severing the inguinal ligament. Staeckel combined an abdominal and inguinal approach to the dissection of these lymph-nodes with an operative mortality of 11 to 15 per cent. The scope and details of the radical groin dissection as we conceive and practice it, will be shown in the following text and illustrations:

INDICATIONS FOR GROIN DISSECTION

Exclusive of certain primary liposarcomas, rhabdomyosarcomas and neurosarcomas which occur by chance in the groin and have no predilection for this location, a greater number of groin dissections are performed for metastatic cancers, either malignant melanoma or epidermoid carcinoma, occurring in the skin of the inferior extremity, male and female genitals, the perineum, peri-anal zone, gluteal region and the infra-umbilical segment of the abdominal wall. The wisdom of performing a groin dissection for clinically recognizable metastatic cancer in the groin is generally accepted. The value of performing bilateral groin dissections for metastatic cancer known to be present in the right and left inguinal groups remains debatable in some schools, but there is sufficient evidence to justify the conclusion that cure is still possible even in these circumstances. The umbilicus, the infra-umbilical or midabdominal skin, the skin of the anus and scrotum, the peri-anal zone and the female genitals all may be involved by cancers which are capable of metastasizing either to the right or the left group of groin nodes or to both groups. The bilaterality of this extension indicates the necessity for bilateral groin dissections, either in one or two stages. Furthermore, the entire procedure of excision of the primary and metastatic cancers in both groins may be performed in one, two or three stages but the preferable procedure, of course, is to excise the primary cancer and the lymph-nodes in both groins *en bloc*, without interrupting the lymphatic connecting pathways, if this is at all possible technically and if the patient is in condition to tolerate such a major ordeal.

Among the postulates for successful groin dissection are the following: (1) The primary cancer, wherever located, should be controlled or controllable and should be treated first. (2) There should be no clinical evidences of blood stream metastases. (3) The lymph stream must be centralward without evidence of blockage and retrograde extension. (4) It should be technically possible to excise all of the lymph-nodes involved or suspected of becoming involved in the immediate neighborhood. (5) There must be some possibility of interruption of the lymphatic spread of the cancer by an excision of these nodes. As an example of this contraindication, one could cite the extension of a carcinoma of the vaginal introitus inward to involve the vaginal mucosa. (6) There should be evidence that the cancer has drained only to the regional groups of nodes to be attacked in the groin dissection.

In aged patients or those in extreme debility, a radical groin dissection as described in this article may necessarily be modified or may have to be abandoned as unfeasible; but barring no such contraindications, it finds suitable application as described in the adjoining context. If the metastatic cancer in the inguinal nodes is too intimately adherent to the femoral or

external iliac vessels as to permit complete local excision, all thought of the operation should be abandoned.

Groin dissection is usually hopeless in the event of numerous secondary nodules in the skin of the lower extremity, intervening between the site of primary tumor and the groin. Even such a radical procedure as groin dissection associated with hip joint disarticulation will not afford an opportunity for cure. This is particularly true in the case of malignant melanoma because this tumor at the time of such widespread local extension has usually invaded some blood vessel with resultant distant metastases.

Of the patients who at some time in the management of their disease, underwent the experience of groin dissection, forty-four of the sixty individuals who had malignant melanoma and thirty-five of the fifty-five who had epidermoid carcinoma, had definite evidence of metastatic involvement of groin nodes on admission.

ELECTIVE GROIN DISSECTION

The caption, "elective," is a misnomer that is used here for the want of a better term. The operation called by this name refers to the elective removal of lymph-nodes in the groin even though they are not palpable and there is no clinical evidence of metastases being present. It is the authors' opinion that this dissection should be done routinely for all melanomas of the extremity and genitals. In a group of seven dissections of this type for melanomas of the lower extremity, two of the patients were found to have microscopically identifiable melanoma in the inguinal lymph-nodes even though the surgeon at the time of operation found no gross evidence of involvement. In another group of ten similar axillary dissections for melanoma of the upper extremities, five or 50 per cent of the series showed microscopic evidence of metastases to the lymph-nodes even though there was no gross evidence determinable preoperatively or during the course of the operation. It is our contention that this early operation, although needlessly done in some instances, affords the patient with metastatic melanoma in the groin a better and earlier opportunity of cure. It seems reasonable that the fewer lymph-nodes involved and the earlier the involvement, the better will the prognosis be. In the case of epidermoid carcinoma, occurring in the lower extremities, this routine dissection is never performed, as one waits until there is evidence of involvement. The reason for this is that this type of cancer does not so frequently metastasize to inguinal nodes and there is a natural wish to avoid unnecessary operations of this major character. For epitheliomas of the scrotum and vulva, however, it is our belief that the bilateral inguinal dissection is constantly indicated even in the absence of palpably enlarged lymph-nodes.

There is no urgency in doing this groin dissection as an elective procedure, as we have shown that an average time of fifteen months elapses from the time the primary melanoma is recognized before the metastases in inguinal nodes are apparent. As a rule, six weeks are permitted to elapse after the primary melanoma has been surgically excised before the second stage or elective groin dissection is done. Patients who refuse this procedure are kept under close and frequent observation. This principle of elective groin dissection is based on a study made several years ago of all malignant tumors of the extremities, which revealed the distressing information that radical dissection of the primary melanoma often was not curative in itself, even in patients in whom no regional lymph-nodes were palpable, because a considerable number of these patients would return during the observational period with large confluent nodes containing metastatic melanoma which was not observed at the previous visit.

SEQUENCE OF TREATMENT OF PRIMARY CANCERS AND METASTASES IN THE GROIN

It is not an indifferent matter to decide whether to remove the primary cancer or

to perform a block dissection of the regional lymph-nodes as the first step in a two-stage procedure. It is a source of great wonderment to read how frequently surgeons advise the dissection of regional lymph-nodes as the initial step of treatment, leaving the management of the original cancer to a later date. Such a plan completely ignores the natural evolution of any cancer. The first tenet necessary for a successful groin dissection is that the primary cancer is cured, controlled or controllable. The plan of treatment wherein groin dissection is first performed, delaying the excision of the original cancer to a later date, is fraught with great dangers. The original cancer does not remain quiescent in its growth during the interval elapsing before treatment is applied directly to it. Metastases continue to occur either intermittently or progressively and these cancer cells, therefore, behave in one of two fashions: either they are poured out directly into the fresh wound of the groin where there is always abundant exudation of lymph and in so doing may produce a widespread locally infiltrating incurable recurrence; or, if the wound is healed to the point where the severed lymphatics are obstructed by the developing scar, the lymph stasis affords the proper setting for lodgment of emboli and retrograde lymphatic permeation, so that by the time the primary cancer is attacked the disease will already have extended superiorly beyond the scope of excisional surgery. The ideal procedure of course is to be able to remove primary cancer and a metastatic cancer *en bloc* which can be achieved in some instances, in malignant tumors of the genitals, for example. But in the case of melanomas of the inferior extremity, a multiple-stage procedure must be usually worked out. We have found from experience that it is unwise to remove a melanoma or epithelioma of the foot and at the same time dissect the groin even though metastases are evidently present, because even here there may be metastases en route.

It requires a nicety of judgment to decide on the interval of inaction when metastases are known to be present and even then the wrong decision may be made. Ten to fourteen days at the most are permitted to elapse before the second stage or groin dissection is accomplished. In the past, the primary cancer, e.g., a melanoma on the foot, and the lymph-nodes in the groin have been removed at a single operative seance only to be followed in too many instances by the appearance of innumerable subcutaneous and intracutaneous nodules along the lymph pathways in the leg and thigh. It is our theoretical belief, substantiated only by personal experience, that the lymph-nodes in the groin should remain to exercise their function as catchment basins or filters for cancer cells which may be metastasizing at the time the primary cancer is removed. The groin dissection should not be postponed too long, if metastases are clinically evident, otherwise the hazard exists of secondary metastasis to the next higher relay or chain of nodes, too far removed superiorly to be surgically excised.

The interval between the first appearance of the primary lesion and the known recognition of metastasis in lymph-nodes of the groin is not the same for all malignant tumors. In the Memorial Hospital series, the interval for epidermoid carcinoma is thirty months and for malignant melanoma only fifteen months, which is in agreement with the usual greater degree of malignancy and the more rapid growth of melanoma. At the two extremes, there is one case report of an instance in which metastasis in the inguinal nodes appeared twelve years after an epithelioma of the foot had been treated and other examples of the simultaneous discovery by the patient of a primary melanoma of the clitoris or vulva and enlarged inguinal nodes, obviously the site of metastatic deposit. The delayed enlargement of these nodes after a lapse of several years indicates that metastases had been present all the

time but remained dormant or latent for some unexplainable reason.

TECHNIC OF RADICAL GROIN DISSECTION

The patient is placed on the table with the corresponding thigh slightly abducted and externally rotated, with the knee slightly flexed over a small sandbag. In the male, the scrotal skin is superficially sutured to the opposite groin, which adequately withdraws the genitals from the operative field. There are no indications for the specific use of various anesthetics. The majority of the operations are performed under spinal anesthesia, which affords good muscular relaxation during the ninety minutes required for the operation.

The skin incision differs from those previously described by Basset and Taussig inasmuch as it entails the removal of a wide ellipse. (Fig. 1.) The motives for removal of the skin are several: it lessens the possibilities of local skin recurrence; it avoids the almost inevitable death and sloughing of the skin which follows the wide fascial dissection which is to be described and it hastens wound healing. The upper extremity of the incision is situated two inches above and one inch medial to the anterior superior iliac spine. From there it sweeps downward in a wide ellipse and then in a medial direction over the inguinal region, then the femoral trigone, to terminate at its lower extremity in the midthigh overlying Hunter's canal. After the skin

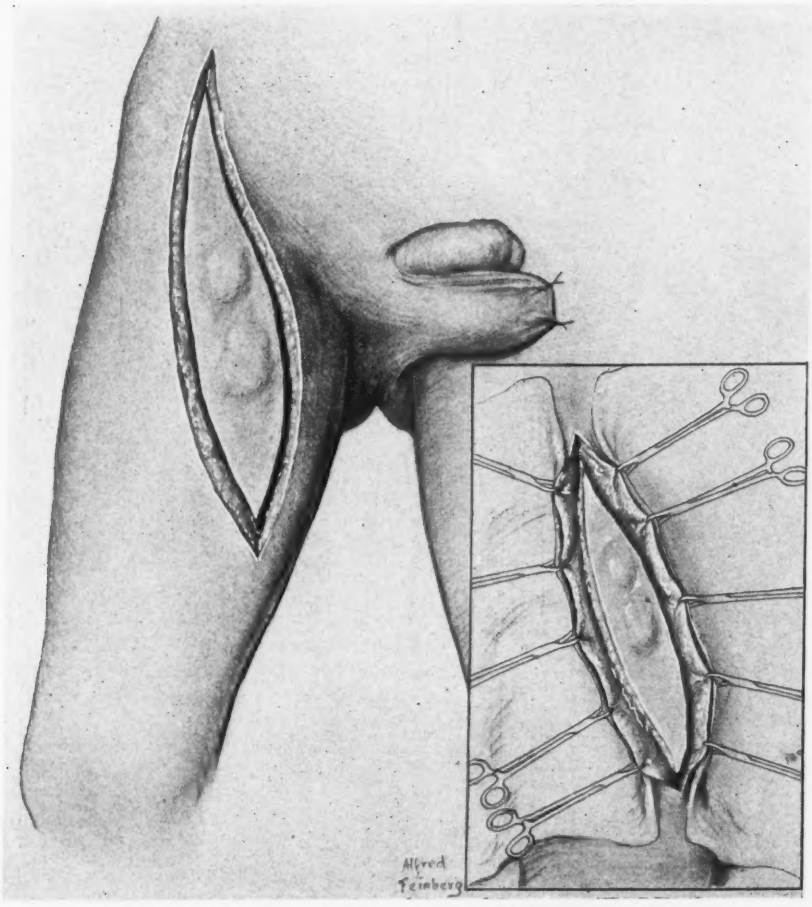

Fig. 1. Scope of incision for groin dissection. The ellipse permits necessary sacrifice of condemned skin. Note direction of incision and upper and lower limits. Scrotal skin is sutured temporarily to opposite thigh. Insert shows use of tenacula to facilitate subcutaneous and fascial dissection.

edges are defined by the scalpel, sterile towels are applied to the lateral wound edges by means of numerous tenacula ligated near its junction with the femoral vein. The dissection proceeds from above downward, removing all the fascia from the

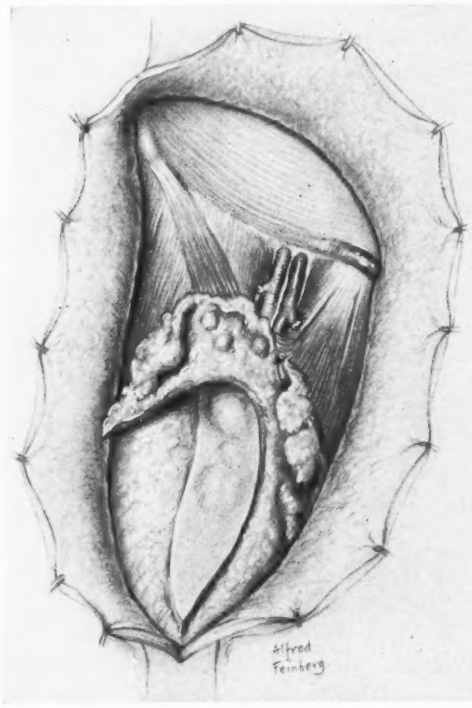

FIG. 2. Superficial stage of groin dissection partly completed. Skin flaps dissected widely back. Lower abdominal, inguinal and femoral regions freed of fat, fascia, lymphoid and areolar tissues from above downward. Observe medial and lateral extent of fascial dissection.

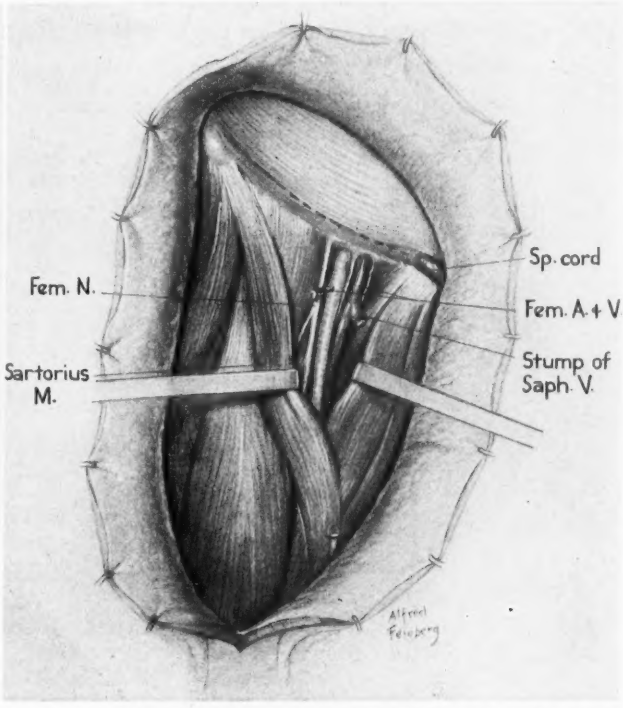

FIG. 3. Completion of superficial stage of groin dissection. The neurovascular femoral bundle has been cleanly dissected down through Hunter's canal. The fascia overlying the pectineus, iliacus, sartorius, adductor brevis and rectus femoris muscles has been removed. Proposed incision to expose the inguinal canal is indicated by the dotted line.

which are very helpful in facilitating subsequent dissection of fat and fascia from the skin. With the tenacula elevated, the subcutaneous fat is now dissected widely in all directions until the entire upper third or two-fifths of the anterior thigh, the inguinal region and lower abdominal wall over the iliac quadrant has been denuded of skin. The dissection now persists deeply to the underlying muscles, through the fascia, which is dissected with the fat and the lymphoid tissues *en bloc* in a medial direction. This dissection is started from above downward, exposing the inguinal canal and finally the femoral vessels. (Fig. 2.) The adventitial layer of the artery and vein is stripped together with the fat and fascia intervening between these vessels. The external saphenous vein is severed and ligated near its junction with the femoral vein. The dissection proceeds from above downward, removing all the fascia from the muscles of the anterior thigh (sartorius, iliacus, pectineus, adductor brevis, rectus femoris). The sartorius muscle is retracted as the dissection proceeds down through Hunter's canal. The external saphenous vein is again severed and ligated where it enters the operative field overlying the middle segment of the sartorius muscle. This bulk of tissue is then removed and the first stage of the groin dissection is considered complete. (Fig. 3.)

At this point the second step is carried out, giving exposure of the inguinal canal which is incised from the external ring to the point where the round ligament or spermatic cord dips downward into the pelvic cavity. The canal is further exposed laterally by incising the external oblique fascia and the transversalis muscles down

to the properitoneal fat. The occasional lymph-node in the inguinal canal is sought for and removed if possible. The external oblique fascia and the inguinal ligament are then severed about two inches from the attachment to the pubic spine. This maneuver opens the femoral ring and improves the exposure of the vessels and lymphoid tissues situated retroperitoneally along the iliac vessels. (Fig. 4.) The lymph-node of Cloquet is usually found resting anteriorly on the femoral vessels just within this ring. In order to secure even greater exposure, deep retractors are inserted to withdraw the peritoneum and abdominal viscera upward and medially out of the operative field. The peritoneal cavity is not entered during the dissection which is carried out entirely retroperitoneally. The chain of lymph-nodes, fat and areolar tissue found along the external iliac vessels are dissected from above downward, including those overlying the obturator foramen. (Fig. 5.) This exposure may be materially aided by preliminary ligation of the deep epigastric vessels where they come off at right angles from the external iliac artery and vein. The entire groin dissection is performed with the scalpel and at the completion of the operation practically no fat nor fascia should be left in the operative field except the normal structures necessary to reconstruct the inguinal ligament and canal.

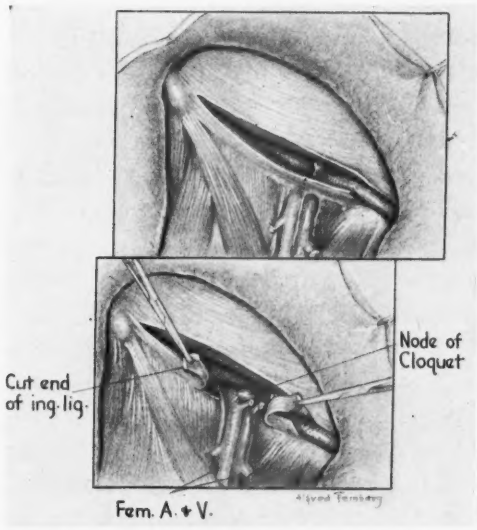

Fig. 4. Exposure of inguinal canal, severance of inguinal ligament and surgical entry into the right retroperitoneal iliac region.

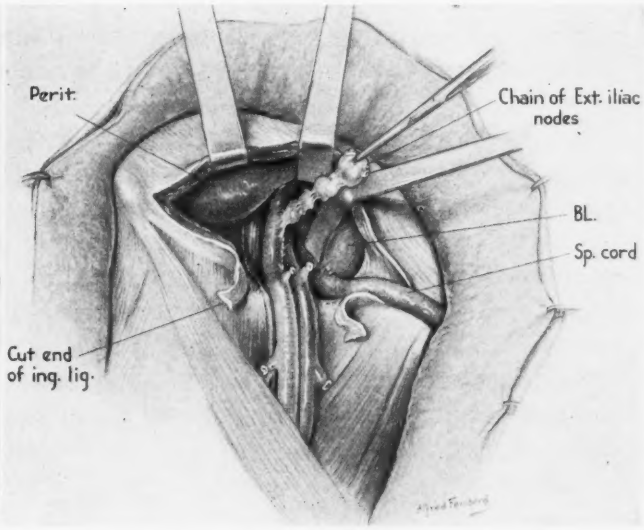

Fig. 5. Dissection of deep iliac lymph-nodes. Displacement of peritoneum medially to afford adequate exposure.

Some surgeons have stressed a preference for performing the external iliac dissection first, continuing with the inguinal femoral dissections later. The advantages of this sequence are more theoretical than practical. The completion of the preliminary superficial dissection affords a more adequate exposure so that the subsequent or continued deep iliac dissection may be radically performed. The inguinal canal is then closed in the manner customary for herniorrhaphy. The inguinal ligament is reconstructed and sutured around the femoral vessels without occluding them. The sartorius muscle is sometimes lightly sutured medially in an attempt to obliterate the so-called "dead space" of Scarpa's triangle and to protect the femoral vessels more adequately. All bleeding vessels are tied with silk ligatures which in our experience has greatly lessened the quantity of serous discharge. The serum which accumulates may be removed by aspiration. If the tumor is fungating through the skin or an irradiation ulcer is present, catgut ligatures are employed and drainage is established through a standard incision placed in the most dependent portion of the

wound on its medial aspect. The skin is usually closed by interrupted silk sutures.

POSTOPERATIVE CARE

The thigh is maintained in slight flexion in order to lessen the tension on the wound edges and to permit the natural fold of the groin to form. It is essential to bring the skin against the underlying muscles otherwise an accumulation of serum soon occurs. A large sterile sea sponge wrapped in gauze is applied over the wound and held in place by a spica bandage. The pressure thereby exerted must be uniform and of the right degree in order to obliterate the dead space and yet it must not be too great for fear of wound necrosis.

COMPLICATIONS

1. *Operative Mortality.* The lethal dangers are immediate or delayed hemorrhage, pneumonia, embolism, septicemia and shock. The hazard of the radical operation is undeniably greater than the superficial groin dissection. The mortality rate is increased when bilateral dissections are done and when groin dissection is done at the same time as vulvectomy, or amputation of the penis or lower extremity. There were two operative deaths in our series of 122 groin dissections of which forty-one were bilateral; the mortality rate therefore was 1.6 per cent. The operative mortality reported by Staeckel was 15.2 per cent for the radical operation and 4 per cent for the more superficial groin dissection. Taussig's operative mortality for groin dissection associated with vulvectomy for cancer was 5.2 per cent.

2. *The complications of pneumonia,* atelectasis, heart failure and embolism occur with the usual frequency in patients who have lower abdominal operations.

3. *Hemorrhage.* Hemorrhage during the operation has never occurred in our personal experience, but it was a complication in one of the groin dissections performed on the mixed tumor service and is reported herein. The common cause of hemorrhage has been late wound necrosis with sloughing and secondary hemorrhage from the femoral vessels due to ill advised preliminary radiation therapy. In one instance, the hemorrhage could be attributed to invasion of the blood vessels by the tumor. There were five postoperative hemorrhages, one of which was fatal (4 per cent).

4. *Wound Infection.* Thirty-two of the 122 groin wounds were badly infected, an incidence of 26 per cent. The wound is almost invariably infected to a certain degree due to the frequency of necrosis of the wound margins. One recent severe infection due to hemolytic streptococci occurred and responded well to chemotherapy. The usual methods of treating wound infections are in order, the most important of which is the establishment of adequate drainage. Gauze impregnated with zinc peroxide and hydrogen peroxide is packed in the wound and hastens sequestration of the slough.

5. *Delayed Wound Healing.* This complication occurred in forty-nine patients or 40 per cent of the groin dissections. The very nature of the operation interferes with the blood supply to the skin flaps. The skin margins of the wound usually survive from four to eight days before the necrosis becomes manifest and demarcation of the dead skin is established. It is well to wait until the necrosis is fairly complete before proceeding with débridement. Delayed wound healing is of some concern to the patient, but really offers no great handicap. This complication has occurred more frequently than necessary in our reported cases because of previous radiation therapy.

6. *Necessity for Skin Grafting.* Twenty-four of the 122 patients required skin grafting, an incidence of 20 per cent. Secondary or delayed skin grafting is always done if the resultant defect is large. It hastens the convalescence of the patient, insures a scar of greater integrity and lessens the degree of lymphedema.

7. *Lymphedema of Lower Extremity.* Lymphedema of the entire lower extremity inevitably follows the radical operation of dissecting the external iliac lymph-nodes.

This lymphedema is apparently increased by the degree of infection and the consequent tightness of the scar. The primary concern is not for the cosmetic disfigurement, the added weight or the discomfort caused by such a leg, but rather for the predisposition to severe recurrent infection with high fever and prostration which sometimes occur. This disturbance between the arterial and lymphaticovenous balance may not be permanent as pointed out by Reichert. The stasis of the lymphaticovenous system provides a stimulus for the regeneration of the lymphatics during the immediate postoperative state. Subsequent attempts at correction may be made either by use of a Kondoleon operation performed in multiple stages or by a Handley lymphangioplasty.

RADIATION THERAPY OF METASTATIC CANCER IN THE GROIN

Radiation therapy of metastatic cancer in the groin is not a curative procedure. At the Memorial Hospital, radium and *x*-rays have been used for twenty years in the vain effort to control this disease. Both external and interstitial irradiation in all the various plans of distribution, from massive single doses to fractionated treatments, have been used without a single instance of five-year cure. Some patients have lived for five to ten years following such treatments, but no microscopical proof of the presence of metastatic cancer is available in these instances. In all analyzed case reports in which biopsies of groin nodes have unequivocally proved the presence of cancer, the patient has died of the disease or of the complications attendant on irradiation. These findings apply both to melanoma and epidermoid carcinoma metastatic to the groin, from such primary sources as skin of the lower extremities, buttocks, lower abdominal wall, vulva, anus and scrotum.

There are numerous factors to account for these failures. Malignant melanoma and the types of epidermoid carcinoma which metastasize to these nodes are notoriously radioresistant. This radioresistance is of such a degree that even the primary cancer is seldom treated solely by irradiation. The skin of the groin is extremely delicate and has an unusually poor blood supply so that it will not tolerate doses of radium and *x*-rays such as are commonly administered through the integument elsewhere as in the neck. The constant moisture aggravates the radiation reaction and impedes the healing process. The lymph-nodes of this location have delicate capsules which are early perforated by the metastatic cancer, which invades the surrounding fat so that growth restraint through swelling of the nodes, ischemia and necrosis, such as occurs in cervical nodes following irradiation, does not occur in the groin. The portal of the area to be irradiated would necessarily have to be very large and this would limit the dose of external irradiation which could safely be given. In contradistinction to the cervical nodes, it is often difficult if not impossible to determine by palpation the involvement of the inguinal nodes by metastases. The late effects of radiation treatment are often disastrous. The skin becomes fibrosed, telangiectatic, hyperkeratotic and dry due to atrophy of the sweat and oil glands. Late ulceration or radionecrosis tardive frequently ensues within six to twenty-four months or later. Such complications often terminate in fatal hemorrhage from the femoral vessels. Interstitial irradiation of inguinal and femoral lymph-nodes is only too often followed by tissue breakdown and a resultant necrotic, infected, painful ulcer which resists all efforts to facilitate healing other than radical surgical excision.

Furthermore, delayed groin dissections in the presence of late radiation changes in the tissues, often associated with ulceration and infection, are hazardous because of the dangers of immediate or late hemorrhage in addition to possible continued extension of the tumor. The operation is technically difficult for several reasons, namely, the degree of fibrosis which handicaps clean

surgical dissection, adhesions to the femoral vessels, and the necessity of sacrificing all of the irradiated skin. The defect in the groin following this procedure cannot be covered well by immediate or secondary skin grafts of the Thiersch or Reverdin types. In lieu of this, transposed skin flaps from the thigh and lower abdomen are necessary to effect a closure of the wound over the exposed blood vessels. (Fig. 6.)

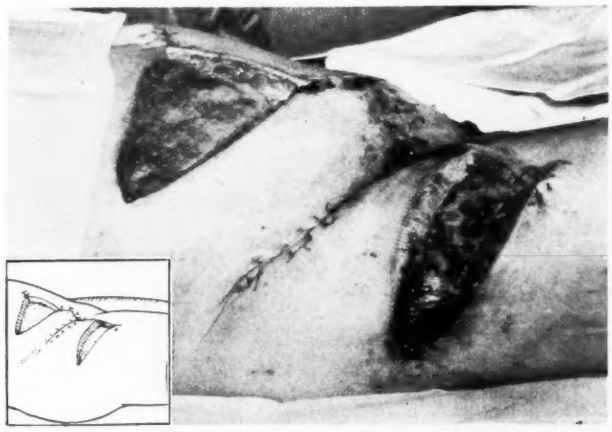

Fig. 6. Groin dissection with excision of fibrotic, telangiectatic, radionecrotic, ulcerated skin and closure of defect over exposed femoral vessels by transposed sliding skin flaps. The triangular defects were then closed by Thiersch grafts. The heavily irradiated, damaged skin in the groin proper was removed as it never would have healed.

The lymphedema of the leg following such irradiation is fully as great as that which occurs after a radical surgical excision and, in addition, the groin is often painful on motion. In conclusion, therefore, one may definitely state that radium and *x*-ray therapy are contraindicated for the treatment of metastatic cancer in the groin. Such tumors as primary or generalized lymphosarcoma involving the groin are best treated by *x*-rays or external radium applications. This is the sole tumor deserving the employment of these agents.

SURGICAL ANATOMY OF LYMPH-NODES IN THE GROIN

There is a certain regional uniformity in the distribution of lymph-nodes in the popliteal, femoral, inguinal and iliac groups. These lymph-nodes are placed with anatomical precision along the course of the lymphatic vessels. As in other parts of the body, almost all of the nodes of the extremity are grouped in the flexor regions of the joints, e.g., popliteal space and the groin.

The inguinal nodes, as we employ the term, refers to all lymph-nodes in the inguinofemoral region. The superficial inguinal lymph-nodes, which average eight to twelve in number, are arranged in four main groups, namely, the superolateral, superomedial, infralateral and inframedial series (Rouviére-Tobias). These superficial inguinal lymph-nodes drain the major number of superficial lymph vessels from the skin of the lower extremity, the labia majora and minora, the praeputium clitoridis, the scrotum, the penis, the buttocks, the perineum, the lumbar, umbilical and infra-umbilical regions and the cutaneous zone of the anus. Some of these lymph-nodes intercommunicate with each other by means of short lymph pathways, but not all intercommunicate.

The chief efferent lymph vessels from the superficial nodes extend either directly into the external iliac lymph-nodes above the inguinal ligament or to the deeper inguinal nodes beneath the fascia. These deep lymph-nodes and those of the retrofemoral group are usually of small size and

few in number, scarcely more than three or four. They are situated laterally and medially to the femoral vein and the uppermost one of this chain is the so-called lymph-node of Cloquet or Rosenmüller which is between the femoral vein and the lacunar ligament. The deep inguinal and retrofemoral lymph-nodes receive the majority of lymphatics accompanying the femoral blood vessels and in addition efferent lymphatics from the superficial inguinal nodes, as previously related, and from the glans penis and glans clitoridis. The efferent trunks from the deep inguinal nodes extend directly into the external iliac lymph-nodes. (Fig. 7.)

These anatomical facts concerning the locations and intercommunications of the nodes in the inguinofemoral and external iliac groups are helpful in enabling the surgeon to anticipate the extension of melanomas and epitheliomas into the groin. The study of these pathways once again confirms the necessity for a radical groin dissection to include the deep inguinal, retrofemoral and external iliac nodes as well. Otherwise, a certain number of patients may not be cured by the more superficial dissection even though the superficial lymph-nodes reveal no microscopic evidence of metastatic cancer.

The apparent number and size of the nodes seem to be influenced by the age of the individual. For example, patients with malignant melanoma are usually of a younger age group and the lymph-nodes appear to the surgeon and pathologist as being more frequent in number, whereas the epidermoid carcinoma of the extremities and genitals occurs in elderly subjects in whom the lymph-nodes seem to have regressed or atrophied with age. An explanation is in order here. Although the lymph-nodes in older people appear to have vanished, they really undergo involution and diminish in size; they do not actually disappear. The presence of infection or even of metastatic cancer in the groin may cause these lymph-nodes to enlarge and become detectable even though not involved by metastases. It often proves confusing to the surgeon as it is not always possible on inspection to determine whether

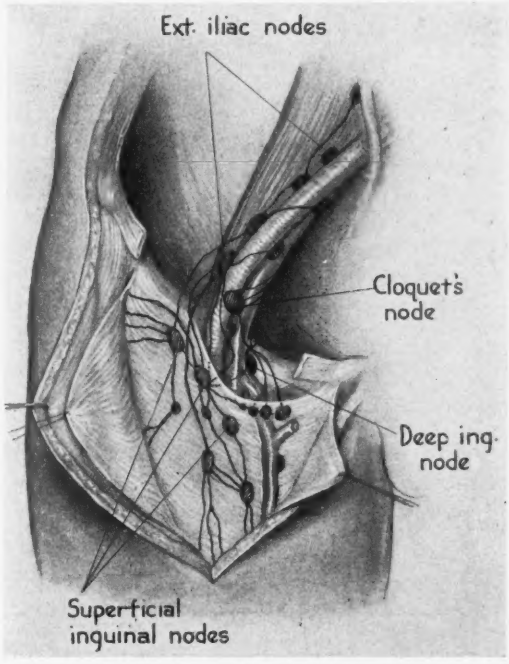

Fig. 7. Distribution of lymph-nodes in the groin (after Rouviere). The superficial inguinal lymph-nodes drain the major number of superficial lymphatics from the lower extremity. The deep inguinal and retrofemoral nodes receive the lymphatics accompanying the femoral vessels. Both groups communicate and may empty into the higher chain of deep iliac lymph-nodes.

or not metastatic cancer is present. The lymph-nodes may involute or regress to a size comparable to the head of a pin, but they do not entirely disappear. On this account, a dissection of the groin and particularly the tissues along the femoral and external iliac vessels must be meticulous in order to remove each and every one of these small intercalated nodes. If a groin dissection has been performed for metastatic cancer and a local recurrence develops which proves on study to be metastasis in a lymph-node, it may be assumed that the dissection was not complete. Lymphatic vessels after severance may re-establish connection across the wound, but lymph-nodes *per se* never regenerate.

PATHOLOGICAL PHYSIOLOGY OF LYMPHATICS DRAINING INTO OR RELATED TO THE GROIN

The dissemination of melanomas and epidermoid carcinomas of the lower extremity, male and female external genitals, skin of the lower abdomen and buttocks may be by direct extension through the planes of tissue cleavage, by blood vessel invasion and vascular metastasis, and by lymphatic embolism or permeation. Direct extension of these tumors occurs through homogeneous tissues along the clefts and tissue cleavage planes which generally offer the lines of least resistance. This extension, therefore, is dependent on physical or mechanical factors governed by such barriers as fascia, capsular sheaths and periosteum. This method of extension is best exemplified in our experience with the liposarcomas, neurosarcomas and rhabdomyosarcomas of the upper thigh and groin and the bulky confluent metastatic melanomas and epidermoid carcinomas of the groin which have perforated the capsules of the lymph-nodes.

Invasion of blood vessels occurs with some frequency by melanomas, seldom by epidermoid carcinomas, except in the rare spindle cell type which develops on the basis of radiation dermatitis and acrodermatitis chronica atrophicans. This route of spread is the result of an infiltrating tumor, which invades the walls of a vein and penetrates into the lumen where it proliferates. Tumor cells then break off and metastasize by embolism widely to the viscera. Arterial wall invasion in the femoral artery with terminal metastases in the toes and foot has been reported, but it is of rare occurrence. The surgeon is occasionally surprised to find that a mass in the groin surgically excised and presumed to be metastatic cancer in femoral lymph-nodes may prove to be a tumor thrombus in the vein, usually one of the tributaries of the saphenous. The prognosis under such circumstances is usually bad because of the liklihood of distant metastases.

In many ways the lymphatic routes are more important. They form an abundant lymphatic network beneath the skin and drain into primary and secondary lymph-nodes arranged in series and ultimately feed into blood vessels. The lymphatic vessels are especially abundant and of greater intricacy in the locations where skin and mucous membranes meet, i.e., mucocutaneous junctions, such as in the vulva, anus and prepuce. Cancer cells may spread through the lymphatic vessels either by lymphatic permeation or by embolism. Lymphatic permeation or lymph-vessel carcinosis or melanomatosis refers to the direct extension of proliferating cancer through a system of preformed crevices or channels, namely, the lymphatics. The occurrence of this phenomenon, especially in the case of melanomas of the extremity and genitals, has been proved by microscopic studies which show in serial sections the presence of a cord of tumor tissue in the lymphatics, whether they be interstitial, perineural or perivascular. The usual direction of extension corresponds with the flow of lymph. In the case of melanomas of the extremity, the affected lymphatic vessels may occasionally appear as black or bluish cords, extending between the primary melanoma and the regional lymph-nodes. Sampson Handley has laid considerable emphasis on this theory as the key to carcinomatous dissemination particularly in the breast, but Willis asserts that it constitutes only one method of dissemination and that a great majority of malignant tumors do not follow this path. In our experience with tumors metastasizing into the groin, lymphatic permeation occurs more frequently by melanomas and only occasionally by epidermoid carcinomas in which the inflammatory element is prominent and in which there is coexistent lymphedema. The process of lymphatic permeation may be simulated by a blockage along the lymphatic pathway so that subsequent backing-up occurs with successive showers of emboli.

The embolic theory of dissemination is more generally accepted and undoubtedly explains a greater number of metastases to groin nodes. Many pathologists have repeatedly examined tissues intervening between the primary carcinoma or melanoma and the lymph-nodes draining these neoplasms and have been unable to detect tumor cells in the intervening or connecting lymphatics, although this may occur in lymphatic permeation which seems to be the exception rather than the rule. The embolic method of spread in the lymphatics of the genitals and lower extremity is proved by certain well known facts. In the fatal cases of melanoma and epidermoid carcinoma there is a high incidence, approaching 100 per cent, of lymph-node involvement. The patient and the physician may observe a large palpable lymph-node in the groin containing metastatic cancer as the first sign of the disease, before the primary tumor, particularly melanoma, becomes apparent. Furthermore, there is a large number of reported cures secured by adequate treatment of primary melanoma or epithelioma of the foot or genitals and proper surgical excision of the femoral and inguinal lymph-nodes only, without any treatment whatsoever to the intervening normal tissues.

Once the cancer is in the lymph-node, it may spread by secondary embolism or even by permeation to another node or chain of nodes. Wherever the involved lymph-nodes are in close anatomical relationship to the femoral or external iliac veins, they may give rise to blood stream invasion and subsequent dissemination. Not all blood-borne metastases can be explained by this phenomenon, however, as some occur due to direct invasion of small veins by the primary tumor and in other instances the small veins of the lymph-node itself may be invaded.

RETROGRADE LYMPHATIC SPREAD

The direction of the lymph stream is normally determined by the lessened resistance of the expanding vessels, by the direction of the valves in the lymph vessels, and by the character of muscle pressure exerted. Lymph flow is usually sluggish and

Fig. 8. To illustrate the possibilities of retrograde lymphatic permeation. This woman had a carcinoma of the uterine cervix treated by *x*-rays and radium with local healing. Right parametrial invasion and involvement of deep iliac nodes with venous stasis caused severe unilateral lymphedema of right lower extremity. The confluent ulcerated nodules involving the skin on the medial aspect of the thigh later developed due to retrograde lymphatic extension downward from the pelvis. Biopsy of the skin reported as epidermoid carcinoma, grade four.

contingent on muscular movements, adequately functioning valves and absence of central obstruction, although the direction of flow is usually proximal or centralward. The direction may be reversed by occlusion of the lymph vessels due to lodgment of tumor emboli or to the blockage of lymph-nodes by cancer tissue. (Fig. 8.) Under these circumstances, the afferent lymphatic is blocked and the flow of lymph may be reversed. Subsequent emboli in the series may become piled up in this distended lymphatic, the valves of which become incompetent through distention. The resultant stagnation of lymph permits retrograde lymphatic permeation. As seen in the groin, particularly in the case of melanomas, this complication results in edema of the extremity and the rapid appearance of myriads of melanotic nodules in the subdermal lymphatics. This process may occur long after the primary tumor has been completely excised and without evidence of local recurrence. This mechanism is of extreme practical importance and

its occurrence must be avoided by the exercise of considerable judgment in the management of metastatic cancer in the groin.

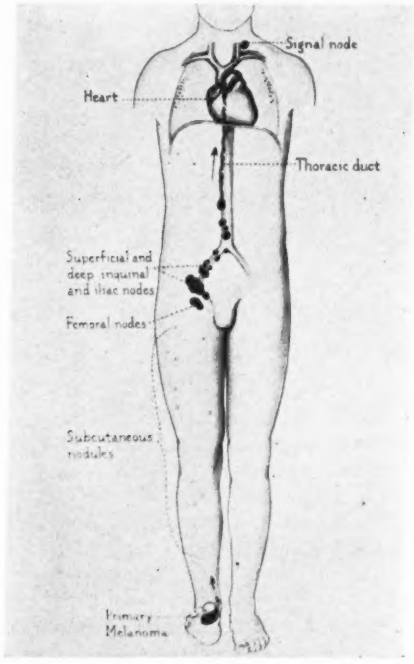

FIG. 9. Primary melanoma of sole of foot, metastatic to femoral, superficial and deep inguinal and iliac nodes. After these lymph-nodes became solidly blocked, lymphedema of the leg occurred, followed by the outcropping of numerous melanotic skin nodules in the edematous extremity.

If a groin dissection is performed before the primary cancer is removed or cured, or if a local recurrence develops at the site of the primary excision at a time following a later groin dissection, this retrograde lymphatic embolism and permeation becomes speedily evident. The initial secondary nodules to make their appearance are usually in the neighborhood of the inguinal and femoral scar where the emboli lodge in the blocked lymphatics. From this time on one may readily see the successive, more or less orderly progression in the development of these nodules subcutaneously and intracutaneously down the thigh and leg. (Fig. 9.) Bearing these facts in mind, it becomes apparent that the factor of timing a groin dissection in relation to the date of excision or treatment of the primary tumor is of major importance. If metastases in the lymph-nodes of the groin are clinically evident at the time the primary tumor is excised, a mistake may be made in the decision as to the proper time for groin dissection. For example, if a toe is amputated for subungual melanoma and at the same operative seance a groin dissection is done, the result may be successful; but if there should be tumor cells in transit, they may lodge in the groin wound and result in a diffuse uninhibited growth which cannot be controlled. If, on the other hand, the large lymph-nodes are not removed shortly, there is the hazard of lymphatic blockage and retrograde extension down the thigh or toward the genitals, thus progressing beyond the scope of curative surgery.

SPREAD OF CANCERS OF THE LOWER EXTREMITY

Rouviére described in detail the lymphatic distribution of the lower extremity. The superficial lymph vessels drain the cutaneous lymphatic network through two layers of collecting vessels, a superficial lymph system in the panniculus adiposus and another more deeply situated pathway beneath the superficial fascia, extending chiefly along the vicinity of the saphenous veins. Both the upper and lower layers of this superficial system intercommunicate and occasionally there are branches which perforate the deep fascia to communicate with the deep collecting lymph vessels. The superficial lymph vessels of the genitals and lower extremity are suprafascial and do not necessarily pattern their course along the blood vessels. The deep lymphatics of the leg and thigh are smaller and usually do run along the vascular sheaths beneath the fascia.

One anomaly that occasionally occurs and is of great clinical importance is the perforation of the fascia at the level of the gluteal fold in the upper posterior thigh, wherein the lymphatics run along the sheath of the sciatic nerve to terminate in the common iliac lymph-nodes. These nodes are beyond the scope of excisional surgery and on this account certain melanomas and anaplastic carcinomas of the

gluteal skin may metastasize directly to the common iliac nodes without any intervening regional-node involvement. This accounts for certain failures to cure these cancers by a wide excision of gluteal skin, fat and fascia associated with homolateral groin dissection even when the primary and secondary tumors are thus removed *en bloc*.

Popliteal Lymph-nodes. The popliteal lymph-nodes are seldom involved by metastases secondary to cancers of the foot and lower leg and, therefore, are commonly ignored by surgeons in planning a method of treatment. The reason for apparent lack of interest in this regional group is because the majority of afferent lymph vessels pass directly up the leg without emptying into these particular nodes. The popliteal nodes are deeply placed in the popliteal fossa and are therefore all subfascial. These three to six nodes are distributed along the course of the popliteal blood vessels. Although they receive afferent lymphatics from the knee joint their practical importance in cancer diagnosis and therapy lies in the fact that they are intercalated in the paths of the lymph collecting vessels from the skin on the lateral aspect of the heel and the posterior half of the lateral border of the foot. (Fig. 10.) It is only in this location that the lymph vessels are superficial as they progress more deeply and finally become subfascial as they ascend the leg. There may be two or three small intercalated nodes intervening between the heel and the popliteal space; these nodes have been variously labelled as anterior tibial, posterior tibial, and tibiofibular lymph-nodes. The afferent lymph vessels from the popliteal nodes drain secondarily into the femoral lymph trunks, thence to the deep femoral and subsequently to the external iliac nodes. The anatomical facts herein related afford two valuable indications for the surgeon in planning treatment. Melanomas primary in the skin of the heel or lateral aspect of the foot should be treated not only by surgical dissection of the heel and groin dissection but by excision of the popliteal lymph-nodes as well. Furthermore, it is possible for a melanoma or

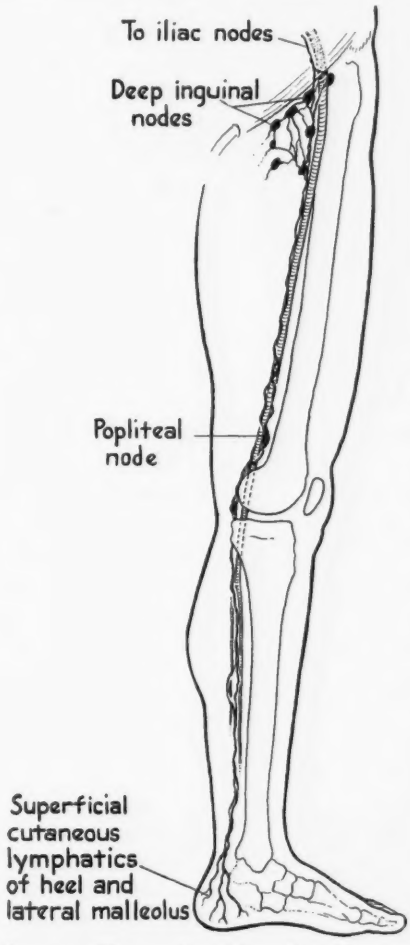

Fig. 10. The popliteal lymph-nodes are intercalated in the paths of the lymph collecting vessels from the skin on the lateral aspect of the heel and the posterior half of the lateral border of the foot. The lymph vessels from the popliteal nodes drain secondarily into the femoral lymph trunks, thence to the deep femoral and subsequently to the external iliac nodes.

anaplastic carcinoma primary in this location to metastasize through the second relay if the popliteal nodes are involved without lodgment in the superficial inguinal nodes. Reliance on palpation of these nodes to determine the presence or absence of metastases in the groin would give a false assurance of safety. Only when the deep nodes are of sufficient size to be palpable could the surgeon be aware of their participation in the extension of the

tumor. On this account, it becomes imperative for the radical deep groin dissection to follow in the course of treatment of superficial inguinal lymph-nodes. Melanomas of the umbilicus, therefore, metastasize to the lymph-nodes of the groin

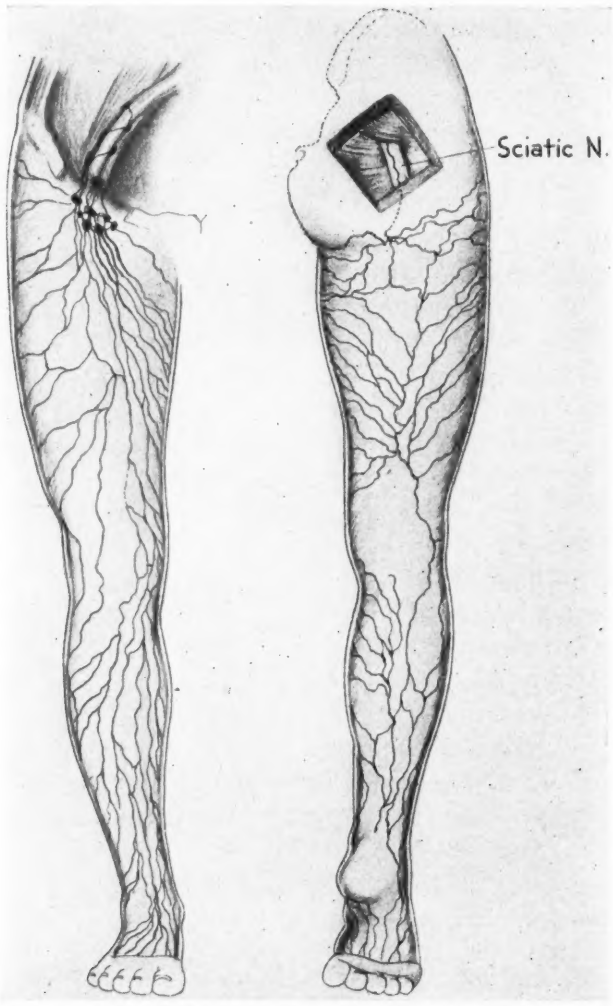

FIG. 11. Superficial lymphatic networks draining the lower extremity. Lymph vessels occasionally accompany the sciatic nerve and permit direct metastasis from gluteal skin to the common iliac lymph-nodes.

all melanomas of the heel, particularly those which metastasize to the popliteal lymph-nodes.

SPREAD OF CANCERS OF THE ABDOMINAL WALL AND GLUTEAL REGION

Rouviere and Tobias pointed out that the lymphatics of the supra- and infra-umbilical regions do not communicate except by very small lymphatic capillaries. The integument of the infra-umbilical region and of the umbilicus proper drains through lymphatics terminating in the rather than to the axillary lymph-nodes. It is also possible for melanomas of the umbilicus to perforate the deep fascia and spread by metastasis through the falsiform ligament to lymph-nodes in the hilum of the liver. Radical groin dissection for melanomas and epitheliomas of the abdominal wall and umbilicus should include wide dissection of the subcutaneous fat and superficial fascia, because there are numerous lymph nodules intercalated along the course of these anterior abdominal lymphatics superior to the inguinal ligament.

One possibility which should be borne in mind by the examining physician is the occasional metastatic involvement of a lymph-node in the eleventh intercostal space posteriorly, where one of the posterior lymphatic vessels terminates. This node must reach a relatively large size and cause pain before it is usually detectable.

Although the skin of the gluteal region is drained by lymphatics which empty into the superficial inguinal lymph-nodes, the possibility has already been mentioned of occasional metastasis to the common iliac nodes by means of lymph vessels accompanying the sciatic nerve. (Fig. 11.)

SPREAD OF CANCERS OF THE PERI-ANAL AND PERINEAL REGIONS

Melanomas and epitheliomas of the peri-anal and perineal regions also metastasize into the medial superficial inguinal lymph-nodes, more commonly those of the infero-medial group. The surgeon who treats tumors in this location must be aware of the fact that the cutaneous lymphatics on both sides of the perineum intercommunicate with each other extensively along the entire median raphe and on this account there is every likelihood that the metastases, if they do occur, will be bilateral. If only one group of lymph-nodes is involved, the dissection should nevertheless be bilateral, under which circumstances the involved side may require a radical groin dissection and the clinically uninvolved side necessitate only a superficial dissection without extension above the inguinal ligament into the pelvis. By this conservatism, both groins may be dissected at the same operation.

SPREAD OF CANCERS OF THE PENIS

The surgeon who treats cancer of this organ should modify the character of the groin dissection based on the portion of the penis involved by the cancer. For example, if the cutaneous envelope of the body of the penis together with the prepuce is involved, the first focus of metastatic deposit is in the superficial inguinal lymph-nodes (superomedial group) and the groin dissection in some instances might be of superficial character without extension

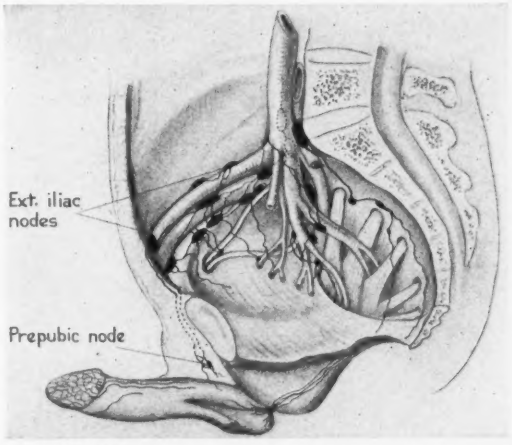

Fig. 12. The prepuce and cutaneous envelope of the body of the penis terminate in the superficial inguinal lymph-nodes. The lymphatics of the glans penis may also extend directly into the external iliac or hypogastric lymph-nodes without intervening stops.

above the inguinal ligaments. If metastases do occur even though palpable only unilaterally, a bilateral dissection should nevertheless be done because the collecting trunks at the root of the organ may separate and run either to the right or left side. Inasmuch as practically all cancers of this organ are infected, the mere presence of enlarged, palpable nodes in one or both groins does not necessarily indicate the presence of tumor metastases, as has been proved by later microscopical study. Aspiration biopsy of these enlarged lymph-nodes may show the presence of metastatic cancer, but a negative report for cancer by this method is not conclusive and the surgeon must remain alert as to the possibilities of cancer being present. The successful treatment of the primary lesion may lead to subsidence in the size of the inguinal nodes to the point of normalcy and some urologic surgeons prefer to accept this condition without surgical interference until more definite evidence of metastases appears.

If the glans is involved, the situation is infinitely more serious because the lymphatics in this region may terminate not

only in the superficial lymph-nodes but directly as well into the deep inguinal nodes and sometimes into the external iliac or hypogastric nodes without intervening stops. (Fig. 12.) Therefore, in the case of malignant melanomas and epitheliomas of the glans penis or glans clitoridis, one must suspect the possible presence of metastases to these deeper lymph-nodes even in the pelvis, without the intervention of superficial lymph-node involvement and must guide one's surgical procedure accordingly.

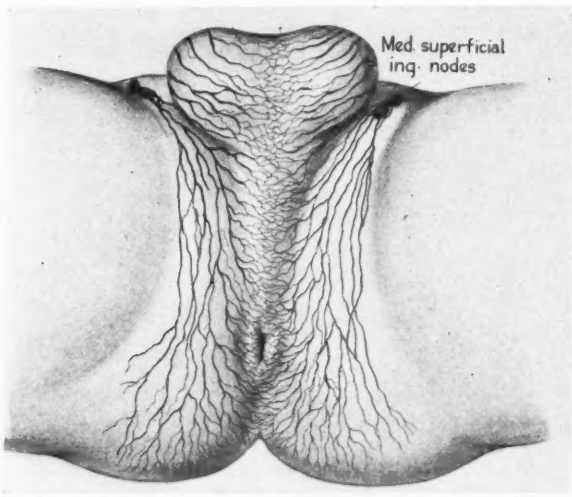

FIG. 13. The remarkable abundance of the lymphatic network throughout the scrotal skin. Observe the free anastomosis across the midline, which accounts for the necessity of bilateral groin dissections for cancers originating in the scrotal skin.

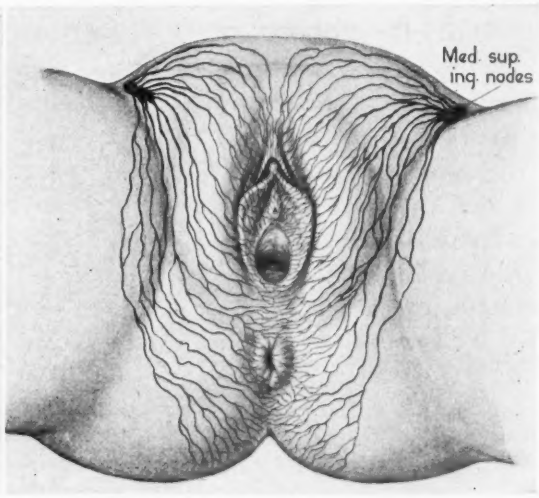

FIG. 14. The lymphatic drainage of the vulva (external to the hymen) is bilateral into the medial superficial inguinal lymph-nodes.

The second anatomical fact which influences the choice of procedure is the existence of a small group of two or three prepubic lymph-nodes which are situated in the midst of the presymphyseal lymphatic plexus which drains the lymphatics of the glans and in turn empties into the external iliac lymph-nodes without a relay into the superficial inguinal nodes. Bearing these facts in mind, the surgeon has good theoretical reasons at least for extending the groin dissection above the inguinal ligament if the primary cancer involves the glans penis or glans clitoridis.

SPREAD OF CANCERS OF THE SCROTUM

A review of the end results of cancers of the scrotum leads to the astounding conclusion that this is one of the most dangerous locations in which cancer may occur. Successful end results in the treatment for epitheliomas of even low-grade malignancy are notoriously rare and if conservative excision only is employed practically no cures are ever obtained in the case of malignant melanoma. The explanation of this tragic picture is the remarkable abundance of the lymphatic network throughout the scrotal skin. The collecting lymph vessels originate along the median raphe and anastomose freely with those of the opposite side. (Fig. 13.) On this account the metastases are nearly always bilateral, and accordingly bilateral groin dissections are indicated. The local treatment of cancer of the scrotal skin must necessitate an almost complete removal of this skin *en bloc* with the inguinal lymph-nodes in order to affect a complete ablation of the disease. It should be emphasized again that the lymphatics of the scrotal skin anastomose freely with those of the penis anteriorly and those of the perineum posteriorly. Therefore, a wide surgical removal of the skin should be done.

SPREAD OF CANCERS OF THE EXTERNAL FEMALE GENITALS

The lymphatics of the clitoris have the same distribution as those of the penis which have been previously considered and

the same method of procedure should be followed in their treatment.

Vagina. Although it has been stated in many texts on gynecology that cancers in the outer third of the vagina behave as do those of the vulva, this definition is not entirely accurate. It is the hymen which is the definite boundary line; the mucous membrane of the vagina internal to this structure drains through its lymphatic network into the deep pelvis lymph-nodes and, therefore, is not concerned in this discussion. The hymen, vestibule and fourchette all drain into the inguinal lymph-nodes and the metastases thereto are treated by the methods previously described.

Vulva. The lymphatic network of the vulva is extraordinarily copious and there is such intimate anastomosis with the opposite side that metastases may readily occur bilaterally or even contralaterally. (Fig. 14.) All epitheliomas or melanomas of the vulva should be suspected of metastasizing to the right and left inguinal groups of lymph-nodes. The method of groin dissection therefore should be bilateral. All of these lymphatics terminate in the superomedial group of superficial lymph-nodes. If a radical vulvectomy is done in one or two stages in the absence of clinical evidence of metastases to the nodes, the dissection may be limited to the superficial, deep inguinal and retrofemoral groups without removing the external iliac nodes above the inguinal ligament. If, however, one group of lymph-nodes is found to contain metastatic cancer, the dissection on that side should extend superiorly in the radical manner. (Fig. 15.)

END RESULTS

The end results do not represent what could be accomplished if the present method of treatment was consistently followed. In years past, the operative procedures were frequently superficial and incomplete. In a cancer institute such as the Memorial Hospital, the percentage of advanced cases or those of borderline operability is much greater than naturally occurs in a general hospital. Preliminary irradiation of the groins, now deemed not only unnecessary but harmful, caused procrastination in the institution of proper surgical treatment.

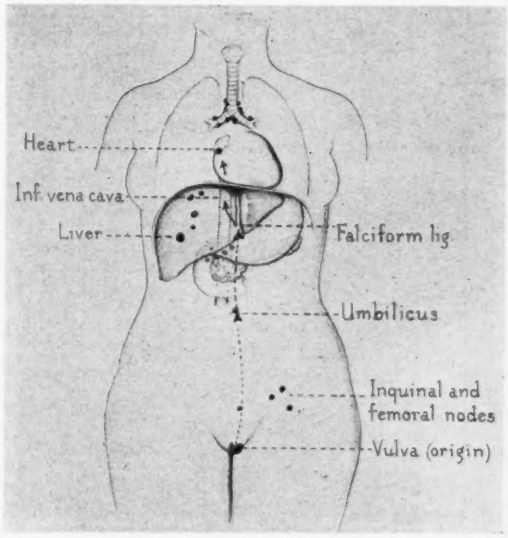

Fig. 15. Melanoma of the vulva metastatic to the inguinal and femoral lymph-nodes in a stage technically operable, were it not for other metastases to small intercalated nodes situated subcutaneously between umbilicus and vulva. Secondary melanotic nodule in umbilicus, thence metastasis via the falciform ligament to the portal fissure of the liver, with later involvement of liver, heart and bronchial lymph-nodes.

Taussig performed nineteen vulvectomies and bilateral groin dissections for cancer with the following results: Twelve of these patients (63 per cent) were living and well for five years; thirteen of nineteen patients had metastasis to lymph-nodes in the groin and of this group, 65 per cent remained free of recurrence.

Daland and Holmes had only three patients (9 per cent) of thirty-five with malignant melanoma who had regional metastases and survived five years without recurrence. Twelve or 25 per cent of their forty-seven patients with melanoma without metastases to regional nodes survived five years without recurrence.

Of 267 patients with melanomas of all locations treated at the Memorial Hospital more than five years ago, thirty-eight or 14.5 per cent were living and well at the end

TABLE I

DATA ON 122 GROIN DISSECTIONS

Type of Primary Tumor	No. Cases	Sex		Groin Dissection				Age			Operative Morbidity					Operative Mortality	Metastasis in Groin Nodes		Time from First Treatment of Primary Cancer to Groin Dissection (months)			End Results							Character of Dissected Groin Nodes	
		Male	Female	Right	Left	Bilateral	Elective	Youngest	Oldest	Average	Gross Infection	Delayed Wound Healing	Hemorrhage	Pneumonia, Atelectasis, etc.	Skin Grafting		Before Admission	After Admission	Earliest	Latest	Average	Recurrent Cancer in Groin	Died of Cancer	Died of Other Disease or Lost Track of	Living and Well N.E.D.	Living with Cancer	Free of Disease: 1 Year	Free of Disease: 3 Years	Free of Disease: 5 Years	Free of Disease: 10 Years	Nodes Free of Metastasis	Nodes Containing Metastatic Cancer
Melanoma of lower extremity	45	24	21	24	21		7 (A)	16	71	45	8	14	2	2	15	1	36	2	0	116	15	10	29	2	12	2	8	2	1	1	6	39
Epithelioma of lower extremity	7	5	2	4	3			36	75	56	4	6	1	1	2		5	2	0	144	32		5	1	1				1	1	
Neurosarcoma of groin	1	1		1				49									1		7				1								1
Rhabdomyosarcoma of groin	3		3	1	2			38	57	47					1		2	1	3	24	15		2		1		1			1	3
Neurosarcoma of buttocks	1		1		1			56			1	1						1	16			1	1								1
Rhabdomyosarcoma of abdomen or back	2	1	1	2				62	69	65	1	1					1	1	0	2				1	1		1				2
Melanoma of abdomen	3	2	1	2		1		26	68	49	1	1	1		1		1	2	2	18	11		3								3
Melanoma of back	3	3		1		2		35	57	43	2	3			1		1	2	1	60	21		1		2		2				5
Melanoma of buttocks	4	1	3	3		1		20	53	40	2	2	1				3	1 (C)	½	58	15	2	2	1	1		1					
Epithelioma of anus	1		1		1			67									1		?					1				1 (D)				
Epithelioma of penis	5	5		1	2	2		29	66	54	1	4			3		3	2	3	62	18	3 (B)	2		3		3			2	5
Epithelioma of scrotum	3	3				3		57	64	60	2	2					2	1	3	12	6	1	1	1	1				1	1	3
Epithelioma of inguinal region	3	3			3		2 (E)	49	71	63	1	1			1		1		2			1	1		2		1	1		2	1
Melanoma of inguinal region	1		1			1		34									1		30				1								1
Melanoma of vulva	2		2	1	1			15	43	29							1	1	0	17			2								2
Melanoma of clitoris	2		2			2	1*	54	67	60	2	2					1	1	same time				1		1		1			3	1
Epithelioma of clitoris	1		1			1	1	60				1							same time				1								1
Epithelioma of vulva	35		35	4	3	28	2*	34	67	55	7	11		2		1	23	10	0	140	18	11	19	1	14	1	6	4	2	3	28	28
Total	122	48	74	44	37	41	13			50	32 (26%)	49 (40%)	5 (4%)	5 (4%)	24 (20%)	2 (1.6%)	83	27				28 (23%)	72	8	39	3	24	8	4	5		

* Nodes do not contain cancer. Elective dissection.

A Two of the seven electively dissected groins contained metastatic melanoma.

B Two of these three patients are now living and well after secondary surgical and radiation treatment.

C Developed metastases in opposite groin.

D Lost to follow up after three years.

E No definite information on character of nodes due to overlying primary cancer. Dissection of nodes considered elective. The nodes did not contain metastatic cancer. Some bilateral dissections showed only unilateral nodal involvement.

of five years. Twelve of forty-five patients (26 per cent) with melanomas of the lower extremity were living and well. There were five ten-year cures and five five-year cures following groin dissections for metastatic cancer of various types. In the case of the forty-one bilateral groin dissections, twenty-two of the patients died and the nineteen living are short of the five-year survival period on which the criterion of cure has been generally founded. The end results in detail are summarized in Table 1.

REFERENCES

1. Barringer, B. S. Inguinal gland metastases in carcinoma of the penis. *J. A. M. A.*, 106: 21–24, 1936.
2. Basset, A. Traitement chirurgical opératoire de l'epithélioma primitif du clitoris; indications, technique; résultats. *Rev. de Chir.*, 46: 546–570, 1912.
3. Daland, E. M. and Holmes, J. A. Malignant melanomas; clinical study. *New England J. Med.*, 220: 651–660, 1939.

3a. Ewing, J. Neoplastic Diseases. 4th ed., pp. 67 and 955. Philadelphia, 1940. W. B. Saunders.

4. Gray's Anatomy. Edited by T. B. Johnston and J. Whillis. 27th ed. New York and London, 1938. Longman Green & Co.
5. Pack, G. T. and LeFevre, R. G. Age and sex distribution and incidence of neoplastic diseases at Memorial Hospital, New York City, with comments on "cancer ages." *J. Cancer Research*, 14: 167–294, 1930.
6. Pack, G. T. and Livingston, E. M. The treatment of pigmented naevi and melanomas. In: Pack, G. T. and Livingston, E. M. The Treatment of Cancer and Allied Diseases. Vol. III, chap. 122, pp. 2071–2094. New York, 1940. Paul B. Hoeber.
7. Pack, G. T. and Wuester, W. O. Treatment of epitheliomas of the skin. In: Pack, G. T. and Livingston, E. M. The Treatment of Cancer and Allied Diseases. Vol. III, chap. 121, pp. 2041–2070. New York, 1940. Paul B. Hoeber.
8. Reichert, F. L. Regeneration of lymphatics. *Arch. Surg.*, 13: 871–881, 1926.
9. Rouviére, Henri. Anatomy of the Human Lymphatic System. Translated by Tobias. Ann Arbor, 1938. Edward Bros.
10. Staeckel, W. Zur Therapie des Vulvakarzinoms. *Zentralbl. f. Gynäk.*, 54: 47–71, 1930.
11. Taussig, F. J. Diseases of the Vulva. Gynecology and Obstetrics. Monograph XIII, chap. 16, pp. 160–164. New York and London, 1931. D. Appleton.
12. Taussig, F. J. Tumors of the vulva. In: Curtis, Gynecology and Obstetrics. Vol. III, chap. 88, pp. 606–610. Philadelphia, 1934. W. B. Saunders.
13. Taussig, F. J. Primary cancer of vulva, vagina and female urethra: five year results. *Surg., Gynec. & Obst.*, 60: 477–478, 1935.
14. Taussig, F. J. Late results in treatment of leucoplakic vulvitis and cancer of vulva. *Am. J. Obst. & Gynec.*, 31: 746–754, 1936.
15. Taussig, F. J. Results of iliac lymphadenectomy with irradiation in borderline cancer of the cervix. *Am. J. Roentgenol.*, 41: 242–247, 1939.
16. Williams, W. R. The Natural History of Cancer, pp. 460 and 464. New York, 1908. William Wood.
17. Willis, R. A. The Spread of Tumours in the Human Body. London, 1934. J. & A. Churchill.
18. Young, H. H. Radical operation for cure of cancer of the penis. *J. Urol.*, 26: 285–294, 1931.

THE SURGICAL TREATMENT OF PERIPHERAL EMBOLISM*

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BY arterial embolism is meant the sudden, complete, shocking closure of a major vessel, usually previously normal, with the resultant threat to the life of the individual and the affected part. The final closure of a vessel already chronically occluded is another picture, because in such chronic closures collateral circulation channels already have been prepared. Surgical treatment of peripheral embolism until recently—and unfortunately in some places still—has been confined to major amputation, if the patient survived until demarcation was complete. Fortunately, surgical therapy has been proved sufficiently successful so that a fair percentage can be saved, not only from death, but from the previous major amputations.

In 80 per cent of embolisms, there is a left-sided heart disease, usually a rheumatic endocarditis. Willis reported that 25 per cent of those who die from heart disease have emboli. There may or may not be arterial disease present. In most instances there is some added insult to the heart, such as auricular fibrillation, a surgical operation or a severe infection. Much less frequently the embolus may arise from either the right side of the heart or the peripheral venous system. These paradoxical occurrences require a patent foramen ovale. In certain instances of arterial disease, local trauma may loosen a plaque which becomes an embolus. More frequently, such injury results in a thrombosis rather than a true embolus.

Symptoms. The outstanding symptoms are a sudden, sharp, shocking *pain*. This is accompanied by *tenderness*, particularly at the site and below the embolus. With this pain is a *loss of function* of the affected part and absence of knee jerks. *Color changes* are striking. The limb becomes marble white with later a blotchy blueness, and with gangrene, a black discoloration. This discoloration may extend above the line of eventual demarcation. The *temperature* of the part changes; the extremity becomes cold. Palpation of the limb shows no arterial pulsations, the blood pressure is absent and the oscillometric readings are 0. At times there is a preliminary, smaller embolus, often unrecognized until the larger, disabling one occurs. Sometimes the embolus may only partially occlude the lumen, to be followed shortly by the complete closure and its symptom syndrome.

The Differential Diagnosis. Usually the diagnosis is not difficult. The history of a patient with a diseased heart, who is fibrillating, or who has had some added insult to the circulatory system, is at once suggestive. No other peripheral condition causes such a sudden change to acute prostration. The differential diagnosis between embolism and *arterial thrombosis* at times may be a problem. The patient with arterial thrombosis has a history of arterial disease, probably involving both extremities. There have been the premonitory symptoms of failing blood supply to the part for some time. Rarely does an acute thrombosis occur as the first symptom. In many instances an *x*-ray will show calcium deposits. In the occasional patient differentiation may not be determined until the operation time. In one patient during the last year, a diagnosis of acute embolism of the saddle type was made on the history. On opening the femoral artery on either side a thrombus of a smaller caliber than the vessel lumen was found. This at once

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indicated that above the femoral site there must be a partial occlusion and probably an intimal plaque. Inability to reopen the artery completely led to a wider exploration of the iliac, after dividing the inguinal ligament. The artery was opened directly through an arterial sclerotic partial occlusion of this vessel. There had been, however, an embolus from a fibrillating heart site, which occluded the already impaired lumen. In some cases it has been possible with the use of a curette to remove this degenerative obstruction. At one time a large obstruction of this nature in the popliteal artery was cleared by a retrograde curettage. With the development of better instruments, further therapy in this line can be undertaken. *Acute thrombophlebitis* is readily differentiated. In thrombophlebitis the foot is warm, cyanotic, enlarged and the veins are distended and tender. Further examination discloses the presence of normal arterial pulsations.

Pathology. The usual location for an *embolus* is at the bifurcation of the artery. Thus we see the saddle embolus at the division of the abdominal aorta, embolus at the junction of the external iliac and hypogastric branches, at the femoral and the femoral profunda area and at the division into the anterior and posterior tibial arteries. (Fig. 1.) Accompanying thrombosis occurs in approximately one-half of the cases of embolism, but in over 90 per cent of the patients it is secondary to the mebolus. It has been seen as early as two hours after the lodgement, but in our longest case no accompanying thrombosis was present. *Spasm* is a marked factor in all embolism, and according to Lund, McKettrick and Allen, is the cause for the pain. Accompanying this spasm, the collateral arteries are closed and a true ischemia of the extremity occurs. In certain instances this spasm relaxes and the collaterals relieve the condition. This known factor has been the basis of certain conservative measures of therapy. It is well to note the difference between closure of a major artery by an embolus and closure by a ligature. Halstead, in 1924, was unable to find gangrene occurring from ligation of the subclavian artery and Mulvihill reported

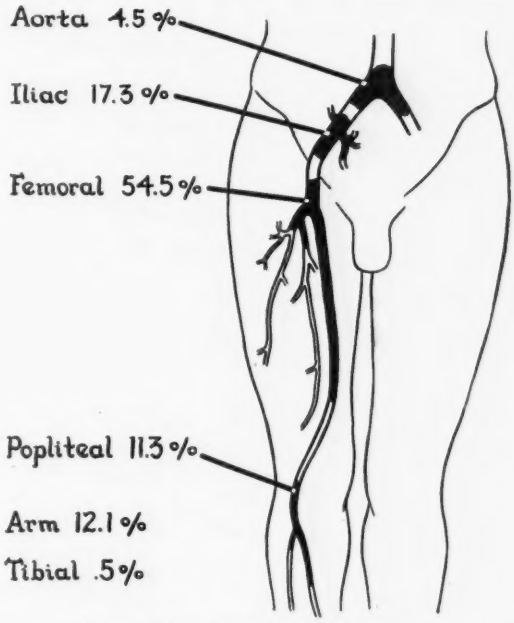

Fig. 1. Sites of embolus lodgment.

an incidence of only 14.7 per cent gangrene in sixty-seven ligations of the common iliac, external iliac and femoral arteries. Wolf found that 50 per cent of the ligations of the common iliac artery resulted in gangrene, while only 15 per cent of the ligations of the popliteal arteries affected the circulation. In the arm a mere 5% of the brachial artery ligations were followed by gangrene. In a ligation of an artery the collateral circulation is frequently adequate. After embolism, however, the thrombus which frequently forms, extends into collateral branches and prevents their function even if spasm can be relieved.

Treatment. The problem in surgical treatment is one of comparatively recent development. A. A. Abanejew performed the first exploration for peripheral embolus in 1895, but failed to locate one. Moynihan, in 1897, removed an embolus from the popliteal artery, but the patient died. In 1907, both Stewart and Doberauer removed emboli with temporary benefit, but thrombosis followed shortly thereafter. Trendelenburg's first effort on pulmonary embolism was in 1907, the patient dying of

hemorrhage on the table. In 1908 to 1909 Proust, Schussi, Murphy, Carell and Leriche all tried the operation with failure.

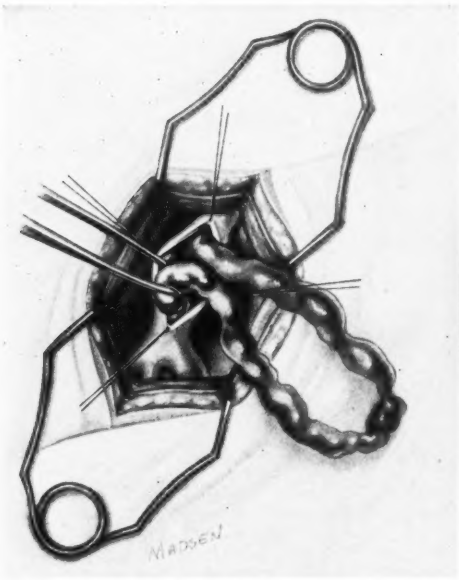

Fig. 2. Removal of thrombus accompanying embolus of the iliac artery. Thrombus is removed from the distal end first.

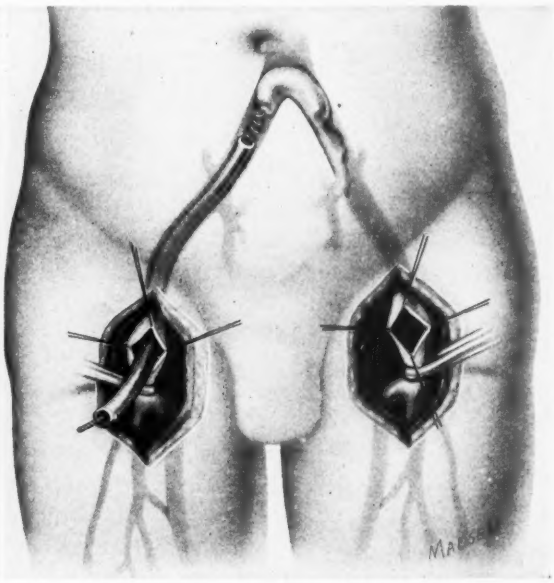

Fig. 3. Removal of embolus, using wire corkscrew protected by catheter. Protection of opposite artery to prevent embolus passage during removal.

The first successful embolectomy (Labey, in 1911) was followed shortly thereafter by Key in Sweden. From 1911 to 1925 nearly all of the operations of this type were done in the Scandinavian countries and the procedure was entirely neglected by surgeons in other countries. While there had been 150 cases in Scandinavia up to 1927, there had been less than twenty reported in the United States, Canada and England. Since that time there have been many successful operations with the Scandinavian figures of 382 embolic operations (with 22½ per cent successful) leading all the others.

It is our belief that the treatment should be surgical as soon as the diagnosis is made. We believe this notwithstanding the fact that occasionally we have seen neglected patients survive. Many such recoveries are not truly embolic. Our experiences with thrombosis in patients with vascular diseases have shown that many cases diagnosed as embolism are not true emboli of the type we are discussing, but are rather the closure of vessels previously constricted, the previous constriction permitting and stimulating adequate collateral development. A few years ago the presentation of the suction pressure boot by Herman and Reid led one author to state that the operation of embolectomy was no longer necessary. We have seen patients go into gangrene and death in a Paevex boot and in one instance the entire epidermis was removed by the suction apparatus. Conservative therapy, we believe, is indicated in these large emboli only until the patient reaches the operating room.

Surgical Technic. Local anesthesia should be the only anesthesia employed and should be utilized without the addition of adrenalin, a severe vasoconstrictor. These patients are in very poor condition and a general or spinal anesthetic often is too great a load for their circulatory system. In no other surgical procedure is gentleness so necessary. The incision for the aortic iliac or femoral embolus is made over the femoral canal just below the inguinal ligament. The vertical incision gives the best exposure. The femoral artery is isolated in the wound and a tape passed around either end of the exposed artery. After placing a fine silk stay suture at either end, the

longitudinal incision is then made in the artery. If a thrombus is present, it is removed from the distal end first, teasing it out with a smooth forceps. (Fig. 2.) With a soft rubber catheter preventing passage of clots below the incision, the proximal end is then removed. The thrombus usually breaks away from the embolus proper, leaving the embolus attached in the lumen. After some experience we have found it best to dislodge the embolus with a wire corkscrew instrument inserted up the artery. To protect the intima, I have introduced the corkscrew covered by a rubber catheter. (Fig. 3.) When the obstruction is reached, the catheter may be withdrawn. Usually, when the corkscrew is withdrawn, the embolus begins to pass. Considerable ingenuity often is necessary to remove the clot, as no one instrument will always be successful. We have borrowed many instruments from the bronchoscopic and urological departments, including the minute biopsy and flexible foreign body instruments. Suction applied to rubber or ureteral catheters may be effective in loosening the obstruction. In the femoral area it is wise to expose the profunda to ascertain its function. One must adapt changes in the technic to the pathological condition present. In one instance Carter was able manually to guide a femoral embolus into a profunda branch, re-establishing the femoral circulation without opening the arterial lumen. If there is not a free flow of spurting blood, it indicates that there is still some obstruction and further efforts are necessary to free the artery. In some instances—well illustrated by one of our patients—incision can be continued through the inguinal ligament and the hand passed retroperitoneally along the large vessels to the bifurcation. The vessel may then be manually milked until the embolus is freed. It is well to permit considerable blood spurting to be sure that no fragments or clots remain.

If there are bilateral symptoms, both femoral arteries should be exposed at once. By lightly constricting the artery of the other side below the incision site, a possible clot passage into the opposite periphery can be prevented. Even when only one side is involved, careful observation of the pulsation of the other foot should be made during and after the removal of the clot for this same reason.

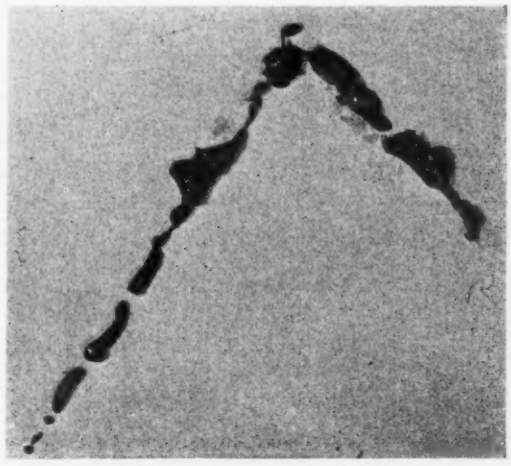

Fig. 4. Embolus removed from bifurcation of aorta.

The arterial wound is closed with fine arterial silk on minute, curved needles. These sutures are placed so as not to enter the intima. In our early cases we frequently oversutured. It is well to remember that the pressure at any point in the arterial wall is inversely proportional to the velocity of the flow. Frequently, a single running suture is sufficient to prevent bleeding. The technic advocated by Carrel and Key of using sutures, instruments and needles coated with vaseline, has been found cumbersome and unnecessary. The needles slip and the fineness of technic required is frequently sacrificed. Irrigation of the artery at the operation with 25 per cent heparin solution is a recent and helpful addition to the technique and probably prevents some immediate thromboses. (Figs. 4 and 5.)

AFTER-CARE

After-care is most important and certain points should be stressed:

1. *The Use of Heparin.* Heparinization has been found valuable in preventing

clotting and while we believe that many of the postoperative thromboses at the operative site are technical errors, we are of the opinion that heparin is indicated. It is given to maintain the clotting level three times below normal. When the cardiac status does not permit continuous intravenous drip, 5 cc. can be given intravenously every two hours, with constant testing of the clotting time.

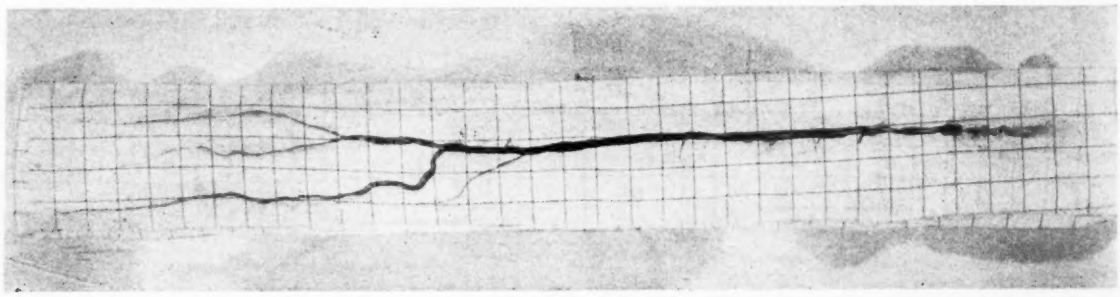

Fig. 5. Embolus with thrombosis of entire artery. Thirty-three inch thrombus removed in one piece. Note thrombosis of the anastomotic branches.

2. *Care of the Limb.* Circulation must be carefully guarded and skin breaks and pressure areas prevented. A soft cotton combine is placed on the heel and the foot wrapped in cotton for warmth and protection. A temperature of from 92° to 96°F. has been found ideal and safely prevents burns. The leg should *not* be elevated, but the use of an oscillating bed, with its gentle arterial massage, is helpful. Unless the cardiac condition prevents their use, antispasmotic drugs are useful at this stage. Papaverin or eupaverine are helpful drugs. Spasmalgin, a drug combining the smooth muscle dilators, atropine, pantopon and papaverin, may be used as often as every two hours, either intravenously or intramuscularly. Whiskey, an excellent vasodilator, is well tolerated and usually welcomed by the patient. It should be remembered that other emboli may occur and if so, re-operation is indicated. One instance is reported by Macfarlane in which an embolus was removed from the right leg, with a second embolus removed from the left leg the next day. This was followed by a third embolus in the first leg at the end of the week, which was also surgically removed and the patient recovered. This is an indication of what can be done in certain instances.

3. *Lumbar sympathetic nerve block* with the introduction of 2 per cent novocaine into the lumbar sympathetics and consequent collateral dilatation and relaxation of spasms, is most helpful at this stage.

It has been proved that conservative measures are unsuccessful. Lund describes twenty-nine patients in whom there was no operation. Twenty-four died in the hospital and six survived, one-half of which lost their legs—an 8 per cent success in contrast to twenty operated cases in which nine patients died and in which there was a 35 per cent success. Similar reports have been made by McMaster, dePemberton, Nyström and Key, while Danzis reported that 87 per cent of the patients not operated upon were dead in a fortnight and all the rest had a major amputation.

In analyzing the patients seen in our own institution, records were reviewed from 1930 to 1940. This review was complicated by the fact that differential diagnosis between embolus and thrombosis was frequently not clear, and by the fact that the fatal complication of embolism frequently was not listed in the diagnosis, the cardiac status being considered primary.

Twenty-six patients were listed, of which twelve were operated upon and five survived—a percentage of 41.6 per cent. Of those who survived without operation, all lost their limbs. Again the possible error in diagnosis of many of this latter group must be emphasized. Personal observations have

been made on sixteen patients with true emboli, twelve of whom have been operated upon and four of whom were not operated upon. Dr. Franklin Carter, of the Post-Graduate Hospital, has had seven such patients, several of whom I have also observed. Of the total patients operated upon thirteen have had the circulation restored. While the percentage of patients living today after this procedure is only 23 per cent, this figure cannot be taken as a true one for embolectomy success. The operative success is actually 61.5 per cent. One must recognize that if the embolectomy restores the circulation, it has been successful. Embolectomy can not be expected to prevent death from an advanced heart lesion or to prevent other phenomena. Patients who die, do not die from the embolectomy, but they die from the lesion causing the embolus. They more frequently die from the gangrene that usually results, or the operation for it, if embolectomy is not performed. This has been statistically proved by many authors. Five patients who were not operated upon in my observation developed gangrene and died.

One other point worth mentioning is that if the patient with an embolus survives and does not have a major amputation, he is a permanent vascular cripple. One patient seen in the clinic in the last three months had such a spontaneous recovery, but now has zero oscillometric readings and such inadequate collaterals that amputation most likely will be necessary. In considering mortality statistics, one is frequently discouraged by the low percentage of patients alive after five years. Were this same discouraging outlook carried to the field of brain surgery or cancer surgery, many patients now cured of lesions would be dead.

The end results in the embolectomies in Sweden showed that one-quarter die in one year, one-half are dead in three years, one-third are alive in five years and one-eighth are alive in ten years. The graph is practically identical with that of those living after excellent surgical and *x*-ray therapy for cancer of the breast. This seems sufficient answer to those surgeons who have stated that the operation is useless, because of the poor risk of the patient group. Certainly no one would advise against operation for cancer of the breast merely because only one-eighth of the patients will survive ten years.

To illustrate what can be accomplished in an apparently hopeless state, I will briefly record experiences with one patient. The removal of a large saddle embolus sixty hours after its lodgement, with survival and complete restoration of circulation in one limb and in the other to the knee is of interest and contrasts with the usual result:

A thirty-nine-year old Baptist minister had a coronary embolism on June 16, 1940. He was treated conservatively with morphine and, after recovering from the acute attack, was transferred by ambulance to a nursing home on June 19, 1940. On June 22, 1940, at 9 A.M. in the morning, he felt numbness and pain in both legs from the hips down. The legs were rubbed and treated with camphor and that afternoon he had a diathermy treatment in both legs. The right leg became severely painful thereafter. No physician saw him that day. The following day the legs were mottled, especially the right one. He was treated by repeated large doses of morphine. On the following day, June 24, there was such severe pain in both legs that the patient could no longer stand it. He was then removed to a hospital. The legs were mottled and the right leg from the midtibial area was black. Both extremities were cold from the hips down and there was a bluish discoloration extending to the crest of the ilium. There was no movement possible in either limb. Oscillometric readings, taken on June 24, were:

0 in the left foot; the right foot was necrotic
0 in both calves
0 in both thighs

No pulsating vessels could be felt and with a high temperature, the patient appeared to be in extremis.

Operative intervention, which ordinarily would have been refused at this late stage, was undertaken because of the attending physician's and the family's insistence and because some thought that the patient's profession gave him a better chance.

Under local anesthesia both femoral arteries were exposed and opened just below the inguinal ligaments. The arteries were empty. The right artery was explored first and many clots removed. A corkscrew, formed from silver wire, was introduced and turned into a hard fibrotic mass at the bifurcation of the abdominal aorta. The embolus was removed in sections and with considerable difficulty. A fairly adequate arterial flow then passed down the femoral artery. On investigating the left femoral artery, many more clots than on the opposite side were found. In spite of several attempts, the embolus could not be dislodged on the left side with the corkscrew, a probe or the sunction catheter. The incision was extended and the hand passed retroperitonially up to the bifurcation in the aorta. With considerable difficulty the embolus was then dislodged and milked distally with the fingers. Following this there was a projection of blood out of the femoral artery of entirely normal force. The incisions in the arteries were then closed and both wounds sutured without drainage.

At once there was improvement in the color of the left leg and foot, and later an improvement in the right leg to the midtibial area. Popliteal arterial pulsation in the left side was present at once and in a few days the dorsalis pedis could be felt. Popliteal pulsation on the right side returned at the same time. From a moribund state the patient improved and within three weeks was sitting up in bed.

The right foot and lower leg demarcated at the tibial area and on July 9, 1940, the patient was transferred to New York Post-Graduate Hospital and on July 17, amputation of the right leg was performed. Progress from that time surgically was satisfactory. There was an improvement of the electrocardiographic readings of the coronary thrombosis. On September 1, 1940, the patient had a small pulmonary embolism with resulting consolidation in the left lower lobe. He recovered from this satisfactorily and was discharged on September 27, 1940.

The successful operation on a patient who was obviously dying of his disease is reported because we know in our experience and feel certain in others, that many apparently hopeless patients have been permitted to die when they might have been saved. We do not expect that many patients as advanced as this can be aided, but one such patient makes the attempt with all worth while.

It appears that the right side closed off earlier than the left, perhaps with an additional tibial embolus. The mottling of the left side indicated a beginning arterial failure on the day of the embolus. Collaterals were probably helpful until the next day, when apparently these likewise failed. A readjustment in the length of time after a lodgment in which surgical intervention may be tried, seems indicated. While our clinic had followed the accepted routine of surgical intervention only if the patient were seen within twelve hours of the occurrence of the embolus, this patient indicates that the arbitrary time limit can be successfully modified in most instances. This procedure will be followed in the future with reversion to the principle so aptly outlined by Sir William Osler, "that no person should be permitted to die of one disease merely because he has another."

SUMMARY

1. The symptoms and differential diagnosis of acute arterial embolism are described.

2. Surgical treatment is preferred to conservative treatment.

3. Surgical technic and after-care are detailed.

4. Experience with twenty-six patients and personal observations on sixteen are described.

5. The case history of a patient on whom embolectomy was performed sixty hours after the lodgment, with recovery, is presented.

THE EFFECT OF PECTIN AND NICKEL PECTINATE ON THE HEALING OF GRANULATING WOUNDS IN ALBINO RATS*

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INTRODUCTION

DURING the last ten years the medical journals have contained a number of reports of the beneficial effects of certain pectin preparations on the healing of external wounds. There has been general agreement that wounds so treated, healed more rapidly, remained clean and that the scar tissue was smoother than when metal pectinates were not used. The work reported in this paper was begun several years ago for the purpose of studying the progress of healing of granulating wounds and, if possible, to obtain some light on the factors which contribute to the favorable results.

It was thought that the effect of the pectinates on tissue growth might be shown more clearly on wounds uncontaminated by infection and since rats are not easily infected they were selected for the purpose. Histological and bacteriological studies were run concurrently and the rate of closure, appearance of the scab, time of crust shedding and smoothness of the scar tissue were used as the criteria for comparison of treated and untreated wounds.

MACROSCOPIC STUDY

The metal pectinates studied were those of silver, nickel, cobalt and copper, and checks were also run with pure pectin. At first, solutions of the metal pectinates containing 20 mEq. of each metal in 100 mil. were used. When qualitative bacteriological studies showed that these solutions had very little effect on the growth of *Staphylococcus aureus* more concentrated solutions were used. After considerable preliminary work it was finally decided to limit this study to the effects of first, a gel containing 5 Gm. of pure pectin in 100 mil. of water and second of a nickel pectinate gel containing 0.032 per cent nickel since this concentration of the nickel seemed to produce the most favorable effect on the healing of wounds. Higher concentrations of nickel seemed to be irritating.

Eighty-three rats of approximately the same age and size were used in the complete study. The hair was removed from the rumps by use of a depilatory and the skin was cleaned with soapy water. Two identical wounds (4 by 10 mm.) were made by cutting through the fascia with a double blade scalpel. The patch of skin was lifted off with forceps. The wound on the right side was treated with the pectin preparation and the one on the left was untreated. Observations were made twice a day at which time fresh gel and bandages were applied. Treatment was usually continued for four days. Figure 1 shows a series of photographs of a single rat at various stages of the healing process. These results are typical. A more rapid diminution in the size of the treated wounds, unaccompanied by any puckering of the surrounding tissue is clearly shown.

* From Wellesley College and The Massachusetts General Hospital.

Table 1 shows the results obtained with various pectin preparations. Using the criteria for comparison previously mentioned, 85 per cent of the wounds treated with pectin or nickel pectinate showed better healing than untreated wounds.

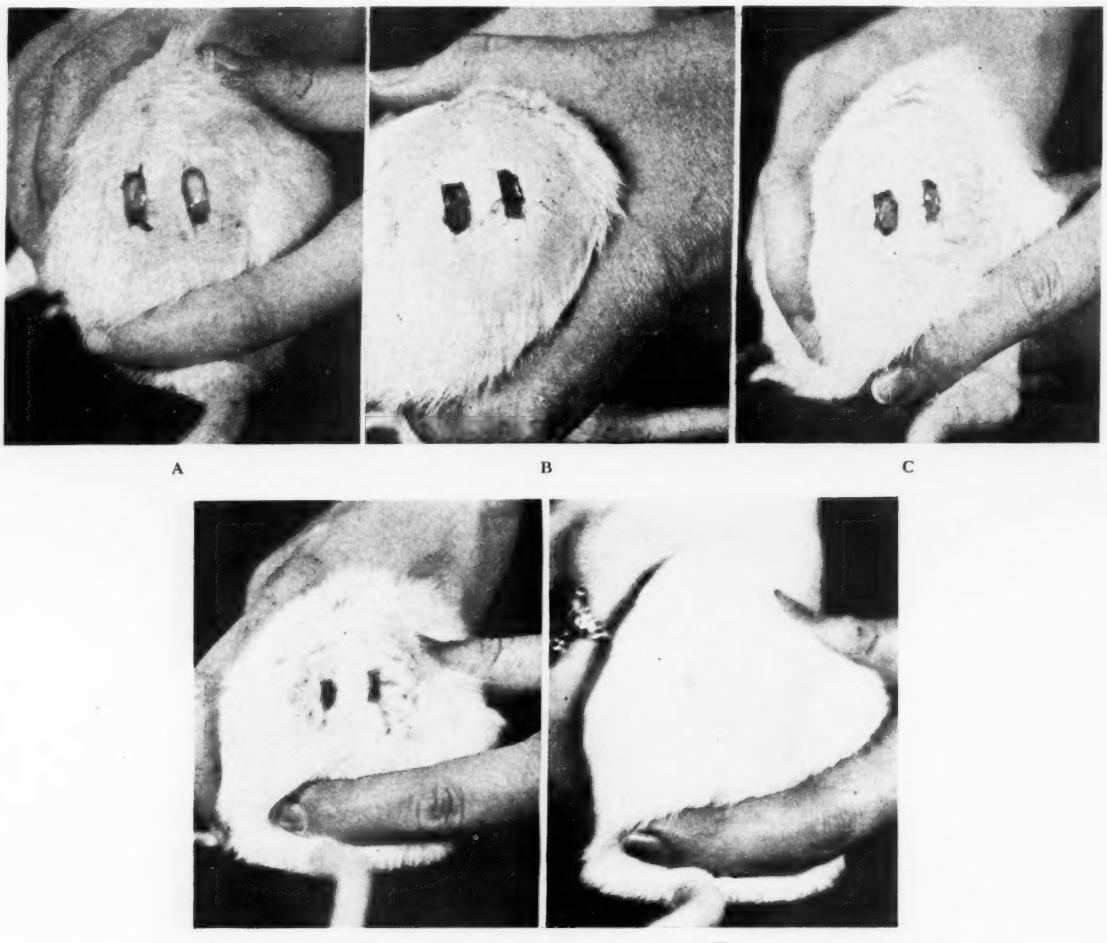

FIG. 1. Appearance of wounds on the rump of the rat in which the right side has been treated with 0.032 per cent nickel pectinate and the left side untreated. A, immediately after operation; B, C, D, E wounds of two, three, five, and eleven days after the operation.

TABLE 1
SHOWING THE EFFECT OF PECTIN TREATMENT ON THE HEALING OF WOUNDS IN RATS

Pectinates	Total No. of Animals	No. Showing Improved Healing on Treated Side	No. Showing Improved Healing on Untreated Side	No Difference in Treated and Untreated Side
Nickel pectinate containing				
0.018% Ni.....	10	8	1	1
0.032% Ni.....	13	11	1	1
0.048% Ni.....	4	0	4	0
5% pectin.....	13	11	2	0

The fact that pectin and nickel pectinate produced almost the same beneficial effect is a matter of interest. The more favorable action of nickel pectinate over plain pectin has been mentioned by several investigators, but our results with uninfected wounds do not give evidence of this. It is true, however, that the bactericidal action of the former is greater; and if the rat wounds had been infected, more marked differences in the effect of the nickel pectinate might have been shown.

HISTOLOGICAL STUDY

Tissue sections were taken from the treated and untreated wounds at 24, 72, 96, 120 and 160 hours after operation. Five animals were used for each period. The sections were fixed in Bouin's picro-formol-

acetic fixative or Zenker's sublimate bichromate mixture. They were embedded in paraffin, cut at 7 μ and stained with Mallory's triple stain for connective tissue or in Delafield's hematoxylin and eosin. Photographs of different but comparable animals, taken at the time the tissue sections were removed, made it possible to follow simultaneously the progress of cell proliferation and wound closure. Figure 2 shows microphotographs of tissue sections taken from typical animals eleven days after the operation when healing was complete. There is evidence that pectinates have a deleterious effect on the epithelial layer. However, in the wounds treated with pectinates granulation tissue filled in faster and was more abundant and more vascular. These results substantiate an observation made by Thompkins et al.,[3] who reported that pectin seemed to inhibit epithelization, but stimulated rapid growth of highly vascular granulation tissue. Because of the apparent retarding effect on epithelization, they suggested the use of pectin only until the wound filled in to a certain degree after which other treatment should be used.

Sections taken earlier in the healing process gave some indication that degeneration of epithelium and inflammation of cells surrounding the wounds are less marked in the wounds treated with nickel pectinate than in those treated with plain pectin. Myers and Rouse[1] have suggested that nickel may act catalytically in hastening the healing process.

Another important factor in the more rapid closure of small wounds treated with these gels is the cohesive force of pectin as it dries and shrinks, thus pulling the cut edges together. This effect would be of little importance, however, in large granulating wounds.

Several investigators have reported that pectin decreases the clotting time of blood and since this might be a factor in the healing of wounds treated with pectin, a brief study was made of the clotting time of rat blood. The technic used was rather crude but the results were clear cut.

Pectin and agar compounds of equal consistency were spread on chemically clean microscope slides and the end of the rat's

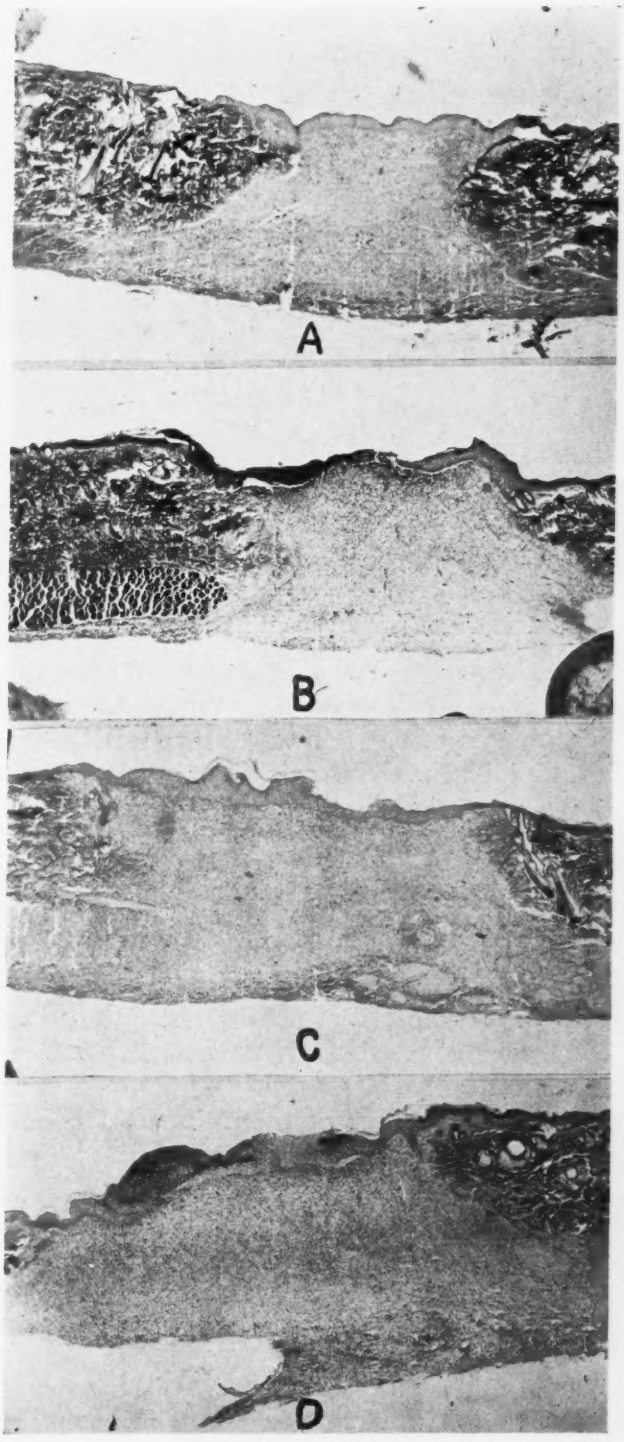

Fig. 2. Photomicrographs of tissue sections taken from scars eleven days after operation. A, rat 30, untreated side; B, rat 30, side treated with 5 per cent pectin; C, rat 24, untreated side; D, rat 24, side treated with .032 per cent nickel pectinate. Note the appearance of the epithelial layer in B and D.

tail was cut off. Three drops of blood from the freely bleeding wound were dropped onto the smears on the slides. Clotting was said to have occurred when a steel needle could pick up the entire blood mass as a soft clot. The average clotting time in minutes for each preparation is shown in Table II.

TABLE II
SHOWING THE EFFECT OF PECTIN AND OF AGAR ON THE CLOTTING TIME OF BLOOD OF THE RAT

Rat Number	Time in Minutes for Blood to Clot When Treated with				
	Nothing in Contact with Glass	0.032% Ni Pectinate	5% Pectin	0.5% Agar	1% Galacturonic Acid in 0.5% Agar
75	6	11	7	7	15
72	7	13.5	11	7	15
79	6	11	6	6	28
80	10	12	10	10	55 no clot
76	5	18	12	..	55 no clot

The results show that the pectin preparations instead of decreasing the clotting time as reported by Violle and Saint-Rat,[3] actually increase the clotting time of rat blood. These authors suggested[3] that the galacturonic acid portion of the pectin complex was responsible for increasing the speed of clotting, but in this study the greatest retardation was produced by galacturonic acid in agar. These results are in agreement with Thompkins et al.[2] who could observe no evidence of any marked hemostatic action of nickel pectinate when applied to external wounds of man. If these pectin gels have an antihemostatic effect, they might produce an unfavorable action if the wounds were bleeding freely. Since skin wounds of rats show slight or no hemorrhage, no such effect was observed in this study.

BACTERIOLOGICAL STUDY

While these experiments on rats were in progress, all of the pectin preparations used were investigated bacteriologically. Qualitative and quantitative methods were employed and the organisms used were two strains of *Staphylococcus aureus* (A and B) which had recently been isolated from cases of urinary infection.

The following qualitative bacteriological procedure was used. The liquid nutrient agar medium was inoculated with twenty-four-hour nutrient broth culture of the organism using 1 mil. of culture for 50 mil. of agar. As soon as the agar had coagulated in the plates, 0.05 mil. of the pectin or metal pectinate gel was placed on the center of the agar film. The plates were incubated at 37°C. for twenty-four hours. The diameter of the clear zone around the drop of gel, free from bacterial colonies, was measured. In Table III the results with the different pectin gels are tabulated. Although silver pectinate was thus shown to be the most effective in inhibiting the growth of *Staphylococcus aureus*, it was not used in this study because its effect on wound healing seemed to be too destructive in character. The same deleterious results were found in less degree with copper and cobalt.

TABLE III
EFFECT OF METAL PECTINATES ON THE GROWTH OF *Staphylococcus aureus*

Strain	Pectinate	Diameter of Clear Zone, Cm.
A	Silver	1.0
A	Copper	0.5
A	Cobalt	0.5
A	Nickel	0.1
A	Bismuth	0.1
A	Pectin	0.1
B	Silver	1.1
B	Copper	0.6
B	Cobalt	0.4
B	Nickel	0.1
B	Bismuth	0.1
B	Pectin	0.1

A more thorough bacteriological study was made of nickel pectinate by the quantitative method. Nickel pectinate was dissolved by steaming in 10 mil. of double strength nutrient broth containing brom thymol blue. Sterile water was added aseptically to bring the volume to 20 mil.

The final concentrations contained 0.009, 0.015, and 0.024 per cent nickel. To a duplicate tube containing the same quantity of pectinate, normal sodium hydroxide was added to bring the reaction of the solution to a hydrogen ion concentration of 7.0 before diluting to 20 mil. with sterile water. Each tube was inoculated with 0.1 mil. of twenty-four-hour broth culture of the organism and stirred well. These cultures were incubated in a water bath at 37°C. for the duration of the experiment. Control cultures of nutrient broth without any pectinate were inoculated at the same time and incubated in the water bath. Plate counts of the pectinate-treated and untreated cultures were made on nutrient agar at twenty-four and forty-eight-hour intervals after inoculation. Counts of the initial number of organisms present in the cultures were also made. In Figure 3 the data obtained in these experiments are presented in the form of graphs.

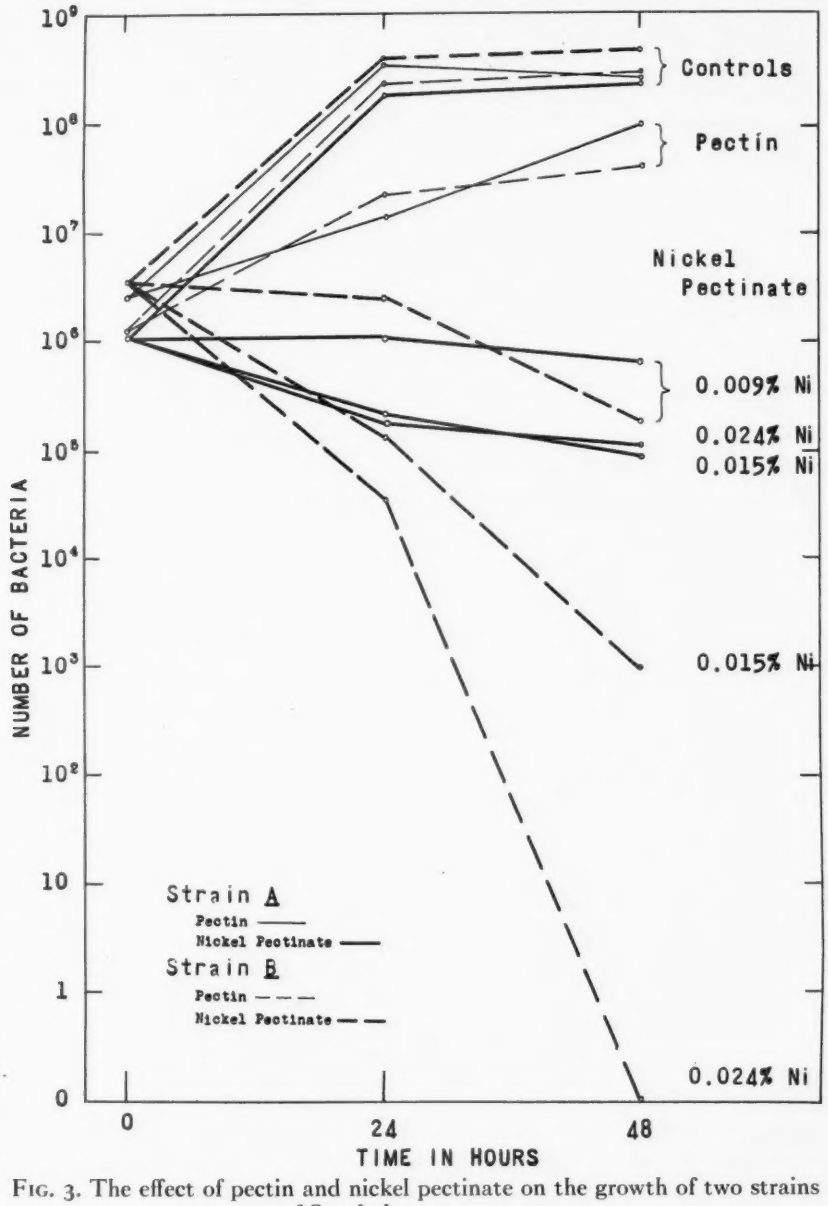

Fig. 3. The effect of pectin and nickel pectinate on the growth of two strains of Staphylococcus aureus.

There was no increase in the bacterial population in any of the cultures treated with nickel pectinate, whereas the control

broth culture showed the typical increase in bacterial numbers. There was a gradual diminution in the number of viable cells in the neutralized cultures while the unneutralized cultures showed a marked increase in growth of the cocci, although the populations were less than those of the control broth cultures. The unneutralized cultures with pectin contained only a few viable cocci after twenty-four hours and were sterile within forty-eight hours.

SUMMARY

1. When wounds made on the rumps of rats were treated with pectin and nickel pectinate gels, in 85 per cent of the cases, the rate of formation of granulation tissue was more rapid and the vascular tissue was firmer than in the untreated wounds.

2. Pectin and nickel pectinate had an adverse effect on epithelization, when treatment was continued for a prolonged period. Microscopically, there is definite evidence that the pectin preparations inhibit the formation of epithelium as shown by bleb formation, ulceration and cellular changes.

3. Bacteriological studies show that nickel pectinate gel containing 0.024 per cent nickel completely inhibits the growth of *Staphylococcus aureus* and has slight germicidal action. A 5 per cent pectin gel has an inhibiting effect on the growth of this organism but does not entirely prevent growth. Clinical work on the use of nickel pectinate on the treatment of wounds is in progress and will be reported in a later paper.

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REFERENCES

1. Myers, P. B. and Rouse, A. H. Pectinates, with special reference to nickel pectinate and their therapeutic value. *Am. J. Dig. Dis.*, 7: 39, 1940.
2. Thompkins, C. A., Crook, G. W., Haynes, E. and Winters, M. Pectin in the treatment of various types of wounds. *Surg., Gynec. & Obst.*, 72: 222, 1941.
3. Violle, H. and Saint-Rat, L. Hemostatic properties of pectin. *Compt. rend.*, 180: 603, 1925.

PERITONEAL ADHESIONS*

STUDIES ON THEIR PREVENTION WITH SODIUM RICINOLEATE

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THE formation of intra-abdominal adhesions, an essential process in the healing of all structures covered by peritoneum, has engaged surgeons since the advent of abdominal surgery. Only when this formation has been excessive, wherein remnants of adult fibrous tissue remain in abnormal regions, can the formation of adhesions be considered unfavorable. Cases in which these remnants disturb the functional efficiency of abdominal viscera are rather numerous and their prevention constitutes an important problem in surgery.

Hertzler[1] emphasizes that "healing by first intention is exactly parallel with the formation of adhesions. The formation of permanent adhesions is a condition not to be prevented but to be controlled, one to be made to take place only where we need them." Unfortunately, even under aseptic conditions, trauma of tissues remote from the site of operative apposition results in the formation of adhesions which bind structures to the abdominal wall or to each other, causing interference with normal function. It is the prevention of these adhesions that has led surgeons to attempt to assist normal healing along controlled lines. Many of these measures have been contrary to essential principles of healing. Others have been designed either to avoid the necessity of healing by care in preventing trauma, or to enhance healing by stimulation of the normal mechanism. The latter methods have been the most successful.

To prevent adhesions is to prevent healing. To control the extent of adhesions is the goal of every surgeon. Thus the problem has been approached with the thought of preventing abnormal apposition of structures. Definite principles have been followed to attain this goal, some have proved to be harmful, some have been harmless, and a few have been beneficial. As Hertzler[1] states, "The idea of preventing adhesions has led to the introduction of anything that could be bent, poured or powdered with the usual result of making matters worse."

I have been able to compile the following methods employed to prevent adhesions:

I. Avoidance of trauma to the peritoneum by
   (1) Careful handling of tissues
   (2) Use of rubber sheets, etc., to protect the peritoneum during operation
   (3) Use of rubber covered clamps to compress tissues
   (4) Avoidance of necrosis of tissues by tight ligatures
   (5) Minimal introduction of foreign materials

II. Operative covering of denuded areas by
   (1) Omental grafts
   (2) Apposition or interposition of intact omentum
   (3) Peritoneal transplants
   (4) Eversion of peritoneal margins into wounds in closure.
   (5) Inversion of peritoneum to cover stumps of ligated vessels, amputated viscera, lines of anastomoses, etc.

III. Mechanical separation of denuded areas by
   (1) Inflation of viscera:
      (A) Boric acid solution in the bladder

*This article was submitted for publication by the author previous to his undertaking his present duties as Executive Officer of the Procurement and Assignment Service.

(B) Enemas or gases in the large bowel

(2) Interposition of

(A) Foreign solid or semisolid materials: 1, Cloth of catgut, fish bladder and calf peritoneum; 2, ox peritoneum (Cargile membrane); 3. oiled silk; 4, silver foil; 5, tin foil; 6, goldbeater skin; 7, lanolin-boric acid paste; 8, agar-gelatin paste; 9, acacia mucilage; 10, acacia-gelatin paste; 11, collodion; 12, aristol powder; 13, iodoform powder

(B) Viscid foreign lubricants: 1, Vitreous of calf eye; 2, mucin; 3, olive oil; 4, liquid petrolatum; 5, vaseline oil (paraffin); 6, yellow vaseline; 7, humanol; 8, omental oil of ox; 9, camphorated oil; 10, lanolin; 11, Lanolin and paraffin

(C) Nonviscid foreign lubricants: 1, Saline solutions; 2. saline-adrenalin solutions; 3, glucose solutions; 4, magnesium sulfate solution; 5, defibrinated blood

(D) Gases: 1, Air; 2, oxygen

(3) Anticoagulants (to prevent coagulation of plastic exudate)

(A) Hirudin

(B) Citrate solutions

(C) Ammonium oxolate solution

(4) Digestants (to remove plastic exudate)

(A) Pus obtained by sterile turpentine abscess of thigh

(B) Pepsin-pregl iodine solution

(C) Peptone

(D) Trypsin

(E) Papain

(5) Postoperative movement of structures

(A) Early movement of patient in bed

(B) Massage of abdomen

(C) Posture to eliminate apposition of operated structures

(D) Stimulation of peristalsis by, 1, local heat to abdomen; 2, drugs

(E) Early movement and exercise of patient out of bed

IV. Stimulation of the peritoneal defense mechanism

(1) Amniotic fluid concentrate

(2) Sodium ricinoleate

The above list serves to confirm the statement of Hertzler,[1] and is elaborate testimony to the inadequacy of any single measure to prevent unfavorable adhesions. Before discussing the results obtained by the above measures it is well to review briefly the processes encountered in the formation of adhesions, processes synonymous with normal healing. The majority of the following is taken from Hertzler.[1]

Primary healing (under favorable conditions, without sepsis, disturbance of coagulation, or the presence of foreign bodies or of digestive juices):

Upon the coaptation of peritoneal surfaces there is an almost immediate outpouring of a clear, structureless exudate which covers the surface. Within ten minutes fibrin is formed within this exudate. This process is completed within one hour and the exudate contracts. In three or four days this fibrinous material begins to be converted without replacement into fibrous tissue, this process being completed within six to eight days. Meanwhile large macrophage cells of the reticulo-endothelial system settle out from the peritoneal fluid onto the healing area, each cell becoming flattened and serving as an island of new endothelial covering. This process results in peritonealization of the denuded surface in seven to ten days. According to Hertzler[1] the peritoneum is well healed in four to seven days. This union affords a protective layer over the muscular and mucosal layers which require much longer to heal.

Delayed or secondary healing (under unfavorable conditions, such as hemorrhage,

interposition of foreign bodies or devitalized tissues, infection, presence of digestive juices and delay or prevention of the coagulation of blood serum):

Under these conditions coaptation is hindered or prevented by the presence of foreign bodies or devitalized tissue, the formation of fibrin is prevented by factors which prevent coagulation, or fibrin is destroyed by the action of digestive juices. Hence the processes of primary healing are delayed and another process intervenes to promote healing. This consists of the development of a granular fibrin, not a fibrillar fibrin as in primary healing. This granular fibrin forms a protective coating to limit the spread of infection. It is later absorbed, then fibrous healing takes place. In overwhelming infections or the sudden extravasation of intestinal contents into the peritoneal cavity, even this granular fibrin cannot form and a less effective attempt is made in the nature of a granular exudate which may agglutinate structures, but which is incapable of forming the temporary adhesions of granular exudate in delayed healing. Agglutinated surfaces offer little resistance to spreading infection. Granular fibrin, if successful, resists spread. Fibrillar fibrin then takes over the function of healing.

From the above it is evident that certain physiological processes are essential to healing of the peritoneum. First, an exudate must be thrown out which is capable of coagulating, thus forming granular of fibrillar fibrin. Second, removal of granular fibrin must be accomplished in order that fibrillar healing may take place. Opie[2] has found that lytic enzymes are elaborated by polymorphonuclear leucocytes which remove this material by digestion. Others have shown that these cells and the monocytes of the reticulo-endothelial system remove foreign material. Third, monocytes must be present which adhere to the surface of the healing area, then flatten to form new endothelium. No doubt there are other important factors, such as elements of blood serum and peritoneal fluid, immune substances of which little is understood. It is assumed by Steinberg[3] and others that the ability of the peritoneum to combat infection is a local process, not a general body immune response.

Jones and McClure[4] summarize a discussion of attempts to prevent adhesions as follows: "Complete solution of the problem lies in perfecting our imitations of those methods by which nature accomplishes the prevention and ablation of adhesions." We know that nature's methods include the outpouring of an exudate of blood serum, the coagulation of this serum with subsequent production of granular or fibrillar fibrin, the digestion of fibrin by lytic enzymes from polymorphonuclear leucocytes, the regeneration of endothelium by monocytes, and the elaboration of certain substances to combat bacteria and toxins.

An analysis of the methods employed to prevent adhesions shows that attempts have been made to assist nature's processes as follows: (1) The covering of denuded areas with insoluble or slowly soluble materials to confine the area of healing; (2) the hastening of coagulation of blood serum (aristol powder) or the substitution of a coagulum (acacia-gelatin, agar-gelatin, collodion, etc.); (3) the separation of structures by lubrication with substitutes for exudate fluid (saline, glucose, dextrose, liquid petrolatum, etc.); (4) assisting or hastening of the digestion of fibrin (peptone, papain, trypsin), and (5) the loosening of temporary adhesions by early movement of structures (early exercise, stimulation of peristalsis, etc.). While there have been both favorable and unfavorable reports on the employment of these measures, the following general conclusions seem to voice the verdict of the recent literature:

Foreign Solid or Semisolid Materials. These have been condemned by Hertzler[1] as follows: "Every conceivable foreign body has been employed in the peritoneal cavity, despite the fact that foreign bodies are the most certain means of provoking

adhesions. For most of them it may be said that they brought about the very thing they were introduced to prevent. The universal rule is, that what the peritoneum cannot absorb, it walls off or dies in the attempt."

Foreign Lubricants, Viscid. Some of these substances have been found to be too irritating while most of them have failed to produce the desired results. Liquid petrolatum was found by Norris and Davison[5] to be encapsulated in multiple tumor-like masses many months after its introduction intraperitoneally. Uncertain results have been reported after the use of olive oil, vaseline and camphorated oil.

Foreign Lubricants, Nonviscid. These substances have served to illustrate the difficulty of retaining an isotonic or hypertonic solution intraperitoneally for a time sufficient to prevent adhesions between structures. Adrenalin was added to saline solutions by Marvel[6] in an attempt to delay absorption. Hypertonic solutions have been found to remain for variable periods of time, somewhat influenced by the balance of fluid between the body tissues, the blood stream and the peritoneal cavity. Indications are that hypertonic solution are rapidly rendered isotonic by osmosis and that the retention of an isotonic solution within the peritoneal cavity demands an excess of fluid within the body tissues and the blood stream if absorption is to be delayed.

Anticoagulants. Hertzler[1] states, "If the blood of an animal is made incoagulable by artificial means, such as by the use of leech extract of peptone, it prevents the formation of primary fibrin bundles, and the wounds will not heal." Pope[7] and Walker and Ferguson[8] found that sodium citrate solutions intraperitoneally were very effective in preventing adhesions, while Straus,[9] Sweet, Chaney and Willson[10] found them to be of no value. Since the coagulation of exudate is necessary to the production of fibrin it is difficult to explain good results on the basis of the prevention of coagulation.

Digestants. The use of digestants has been based on the findings of Opie[2] that polymorphonuclear leucocytes elaborate lytic enzymes which digest fibrin. The use of papain solutions has met with pronounced success in the hands of Kubota,[11] Ochsner and his associates,[12] Walton[13] and Yardumian and Cooper.[14] It is well known that the escape of digestive material from the stomach, pancreas or intestine prevents healing and frequently results in peritonitis and death from inability of the organism to wall off infection. Johnson[15] and his associates emphasize that the digestive action of papain and pepsin is dangerous in cases likely to develop postoperative infection, in that these materials destroy a first line of defense. Under aseptic conditions, however, papain solutions have been shown to prevent 90.89 per cent of the recurrence of adhesions in experiments conducted by Ochsner and Garside.[16]

Peritoneal Stimulants. While amniotic fluid concentrate and sodium ricinoleate are listed under this heading, it is recognized that any substance which causes an irritation to the peritoneum must be classed as a stimulant. Pfeiffer and Issaeff[17] demonstrated in 1894 that the intraperitoneal injection of normal broth, peptone or urine so altered the local defense of the peritoneum of guinea pigs that they could subsequently withstand doses of cholera vibrio that would otherwise be fatal. Morton[18] found that local peritoneal immunity to hemolytic streptococci could be produced in rabbits by the injection of dextrose broth, 1 per cent sodium chloride solution and varying concentrations of glucose in water or in saline. Hermann,[19] Bargen,[20] Judd and Waldron,[21] and Dixon and Bargen[22] have shown that local peritoneal immunity is stimulated by the injection of killed suspensions of *Escherichia coli* and hemolytic streptococci, and in more than 1,500 cases so stimulated forty-eight hours prior to elective resection of the colon, mortality from peritonitis has been reduced 66 per cent. It is probable that much of the beneficial effect attributed to many of the

solutions introduced intraperitoneally has been due to this peritoneal stimulation by nonspecific substances. Seeley, Higgins and Mann[23] demonstrated that even sterile distilled water provoked an influx of 19.0 per cent polymorphonuclear neutrophils after six hours. Amniotic fluid concentrate, antiperitonitis vaccine (Bargen[22]) and 2.0 per cent sodium ricinoleate resulted in an influx of 36 per cent, 51 per cent, and 72 per cent, respectively, after three hours. The normal peritoneal fluid of the white rat does not contain polymorphonuclear neutrophils.

This response in the peritoneum may be referred to as stimulation. It is important that the degree of stimulation be below the level of detrimental irritation. I have found that 1.0 per cent sodium ricinoleate is well tolerated intraperitoneally by rabbits, but that 2.0 per cent will occasionally result in death. Corwin[24] reports the same experience. In monkeys I have tested sodium ricinoleate intraperitoneally in concentrations varying from 0.25 to 4.0 per cent and found it to be well tolerated. White rats tolerated 2.0 per cent sodium ricinoleate very well. Johnson[15] reports that 1.0 per cent sodium ricinoleate causes destruction of peritoneal endothelium in dogs. That 1.0 per cent sodium ricinoleate is well tolerated intraperitoneally in the human is attested to by the experience of Wangensteen[25] and Gillette.[26] Wangensteen[27] uses 1.0 per cent sodium ricinoleate to cleanse all mucous surfaces in gastric and intestinal anastomoses and employs 90 cc. of 1.0 per cent sodium ricinoleate in a 70 kilogram man for peritonitis. Gillette[26] has used 1.0 per cent sodium ricinoleate intraperitoneally in over 300 cases of peritonitis, instilling 50 cc. at twelve-hour intervals. He believes it to be of definite value.

Conflicting reports have appeared in the literature on the value of amniotic fluid concentrate in the prevention of adhesions. Johnson,[28] Warren,[29] Trusler[30] and Kimpton[31] report excellent results in the prevention of adhesions experimentally and clinically. Rea and Wangensteen[32] found that it prevented adhesions in 70 per cent of rabbits in which the intestine had been traumatized and painted with tincture of iodine. They found that 1.0 per cent sodium ricinoleate prevented adhesions in 85 per cent of rabbits in a similar series. Lacey[33] reported amniotic fluid was harmless when injected intraperitoneally, that it seemed to stimulate the peritoneum to a more powerful defense action, but that it could not be depended upon to prevent adhesions. Gepfert[34] reported that after trauma to the bowel and stomach of dogs, repeated operations to separate adhesions resulted in the formation of fewer and less dense adhesions when amniotic fluid was used.

EVALUATION OF THE EFFECTS OF SODIUM RICINOLEATE INTRAPERITONEALLY

Sodium ricinoleate is a soap, the sodium salt of ricinoleic acid. Larson[35] and his associates have demonstrated that it has strong bactericidal, bacteriostatic and detoxifying properties, and that it is well tolerated intraperitoneally in experimental animals. Seeley, Higgins and Mann[23] compared the effect of 2.0 per cent sodium ricinoleate, antiperitonitis vaccine (Bargen[20]) and concentrated amniotic fluid when injected intraperitoneally into white rats. The total number of cells present in the peritoneal fluid and the amount of peritoneal fluid was determined at intervals with the following results: (Table 1).

Corwin[24] reported similar results in rabbits when he compared the effect of intraperitoneal injection of 1.0 per cent sodium ricinoleate and antiperitonitis vaccine.

Rea[36] reported excellent results following the use of three or four ounces of 1 per cent sodium ricinoleate intraperitoneally in cases of gross or suspected contamination.

In these studies it will be noted that sodium ricinoleate was highly effective in provoking an increase of neutrophils and monocytes and was especially effective in provoking an increase in the amount of peritoneal fluid which persisted for seven days in rats and for five days in rabbits. In

a study to determine the mechanism of this increase in peritoneal fluid, Rider[37] found that sodium ricinoleate behaved in solution more like a crystalloid than a colloid, that it was readily dialyzed and that it was incapable of producing an increase in its own volume on a purely osmotic basis. He concluded that the increase of fluid within the peritoneal cavity after the introduction of sodium ricinoleate was not due to purely physical effects but to some effect on secretory mechanisms.

Forty-eight monkeys were divided into eight groups. Intraperitoneal injections were given, each group receiving different concentrations of sodium ricinoleate as prepared above. In order to standardize the dose, it was decided to give 3 cc. of solution for each kilogram of body weight. On this basis, an adult human weighing 70 kg. would receive a dose of 210 cc. Intraperitoneal injection was made by suspending the animals by their hind limbs, thus allowing the viscera to fall toward the diaphragm. The solution was introduced midway between the umbilicus and symphisis pubis. Before this method was used faulty injections frequently resulted because of movement of the animals.

TABLE I

INTERVAL IN HOURS AFTER INJECTION

Cells in millions; fluid in milligrams

Solution used		Control	1	3	6	12	24	48	72	168
Amniotic fluid conc. (amfetin)	Monocytes	18.01	14.77	11.37	11.58	10.52	13.77	12.43	20.30	30.47
	Neutrophils	.08	1.22	8.72	8.50	4.96	3.65	.58	.47	.08
	Wt. of fluid	223.	546.	357.	295.	160.	194.	159.	228.	335.
Antiperitonitis vaccine (Bergen)	Monocytes	18.01	9.43	9.10	10.67	10.15	26.78	24.51	23.90	24.25
	Neutrophils	.08	1.17	13.37	9.83	7.30	8.71	2.31	.72	.20
	Wt. of fluid	223.	259.	280.	238.	190.	354.	213.	246.	257.
Sodium ricinoleate 2.0 per cent	Monocytes	18.01	11.25	8.17	15.60	11.56	30.	43.35	65.29	24.65
	Neutrophils	.08	7.12	21.53	23.76	7.45	12.15	8.75	9.11	.51
	Wt. of fluid	223.	3692.	3177.	3373.	988.	1522.	1583.	2013.	581.

Further properties of sodium ricinoleate have been evaluated by the following experiments:

STUDIES ON THE TOLERANCE OF SODIUM RICINOLEATE WITHIN THE PERITONEAL CAVITY OF THE MONKEY

In order to determine the effect of various concentrations of sodium ricinoleate within the peritoneal cavity of the monkey, the following experiments were conducted. Monkeys (*Pitheous mindanensis mindamensis*) were procured from plantations in the southern Philippines. They were housed in large pens with shelters and observed for three months for any evidence of mortality from disease. All were healthy and none died during the period of observation except from fighting.

A standard solution (40 per cent) of sodium ricinoleate was used for stock. A series of eight dilutions were prepared as follows: 0.25 per cent, 0.5 per cent, 1.0 per cent, 2.0 per cent, 3.0 per cent and 4.0 per cent in distilled water, 2.0 per cent in normal saline and 2.0 per cent in concentrated amniotic fluid.

Following injection, animals of each group were killed at intervals from twenty-four hours to twenty-one days. Death was produced by exsanguination following administration of a light chloroform anesthesia. A complete necropsy was carried out in each case, and particular attention was given to the degree of inflammation present and to the amount of fibrinous exudate or adhesions existing within the peritoneal cavity. Portions of the liver, kidney, spleen, small intestine and anterior

abdominal wall were fixed in formalin, sectioned and stained for histologic examination. Five control animals were killed in a similar way and similar tissue specimens were removed for comparative study.

saline than in the series injected with 2.0 per cent in distilled water. The degree of inflammation in the series injected with 2.0 per cent in concentrated amniotic fluid was approximately the same as in the series

TABLE II

Table II
SUMMARY OF EXPERIMENTS

Experiment	Sex	Weight, Kg.	Sodium ricinoleate, concentration and diluent	Cc. of solution	Interval after injection until killed	Inflammation of peritoneal cavity	Adhesions of peritoneal cavity	Comments
1	M	4.0	0.25% in dist. water	12.0	24 hours	–	–	Discarded. Injection into transverse colon
2	M	4.0	0.25% in dist. water	12.0	48 hours	+	++	Omentum adherent to small bowel
3	M	4.0	0.25% in dist. water	12.0	4 days	+		Necrosis of descending colon, well walled off. Faulty injection
4	M	4.0	0.25% in dist. water	12.0	7 days	0	0	Normal
5	F	2.5	0.25% in dist. water	7.5	14 days	0	0	Normal
6	F	3.5	0.25% in dist. water	10.5	21 days	0	0	Normal
7	F	4.0	0.5 % in dist. water	12.0	24 hours	+	0	Mild inflammation of peritoneum
8	M	4.0	0.5 % in dist. water	12.0	48 hours	0	0	Entirely normal
9	M	3.0	0.5 % in dist. water	9.0	4 days	+	+	Very slight inflammation at site of injection with adhesion of omentum to belly wall this region
10	M	4.0	0.5 % in dist. water	12.0	7 days	0	0	Normal
11	F	3.5	0.5 % in dist. water	4.5	21 days	0	0	Normal
12	F	4.5	1.0 % in dist. water	13.5	24 hours	+++	+++	Generalized fresh, loosely matted adhesions belly wall, omentum and intestines
13	F	1.5	1.0 % in dist. water	4.5	48 hours	+	+	One small fresh adhesion between mesentery and cecum
14	F	2.0	1.0 % in dist. water	6.0	72 hours	0	+	Injection partially into anterior wall. One small fresh adhesion of bowel loop to site of injection
15	M	1.5	1.0 % in dist. water	4.5	7 days	+	0	Normal except mild omental inflammation
16	M	1.0	1.0 % in dist. water	3.0	14 days	0	0	Normal
17	M	4.0	1.0 % in dist. water	12.0	21 days	0	0	Normal
18	F	5.0	1.0 % in dist. water	15.0	21 days	0	0	Normal
19	F	3.0	1.0 % in dist. water	9.0	21 days	0	0	Normal
20	F	3.0	2 % in dist. water	9.0	24 hours	–	–	Discarded. Injection into transverse colon
21	F	2.5	2 % in dist. water	7.5	48 hours	++++	+++	Marked reaction. Matting of intestines. Generalized adhesions - early
22	F	2.0	2 % in dist. water	6.0	72 hours	++	++	Fresh membranous adhesions - mesentery and omentum
23	F	2.5	2 % in dist. water	7.5	7 days	0	+	Recent adhesion of omentum to mesentery of small bowel and colon
24	F	1.5	2 % in dist. water	4.5	14 days	0	0	Normal
25	F	3.5	2 % in dist. water	10.5	18 days	0	0	Normal
26	F	5.0	2 % in dist. water	15.0	19 days	–	–	All of injection into anterior wall. Nonsuppurating mass in wall
27	F	3.0	2 % in dist. water	9.0	21 days	0	0	Normal
28	F	4.0	2 % in .9% NaCl	12.0	24 hours	++++	+++	Generalized inflammatory reaction
29	F	2.0	2 % in .9% NaCl	6.0	48 hours	+++	++	Matting of intestines
30	F	2.0	2 % in .9% NaCl	6.0	4 days	+++	++	Inflammation, hemorrhagic. Intestine matted
31	M	2.0	2 % in .9% NaCl	6.0	7 days	0	0	Normal
32	F	2.5	2 % in .9% NaCl	7.5	21 days	0	+	Omentum slightly adherent to anterior wall
33	M	3.5	2 % in amfetin	10.5	24 hours	++	+	Omentum adherent to large bowel
34	M	5.5	2 % in amfetin	16.5	48 hours	+++	++	Intestines loosely matted by adhesions, early
35	M	3.5	2 % in amfetin	10.5	4 days	+	+	Moderate adhesions between intestinal loops
36	M	2.7	2 % in amfetin	8.0	7 days	0	+	Omentum adherent to anterior wall
37	F	2.5	2 % in amfetin	7.5	21 days	0	++	Adhesions of omentum; dense, to lateral and anterior walls
38	M	3.0	3 % in dist. water	9.0	24 hours	+++	++	Inflammation, hemorrhagic. Adhesions of omentum to small intestine
40	F	3.0	3 % in dist. water	9.0	48 hours	++	++	Intestines matted
41	M	4.0	3 % in dist. water	12.0	72 hours	++	0	
42	F	2.5	3 % in dist. water	7.5	7 days	–	–	Localized abscess, well walled off
43	F	2.5	3 % in dist. water	7.5	14 days	0	+	One adhesion. Omentum to anterior wall
44	M	2.5	3 % in dist. water	7.5	21 days	0	0	Normal
45	F	3.0	3 % in dist. water	9.0	21 days	0	0	Normal
46	F	4.0	3 % in dist. water	12.0	21 days	0	+	Adhesion - omentum to small intestine and anterior wall
47	M	5.0	4 % in dist. water	15.0	76 hours	–	–	Generalized severe inflammation and adhesions due to faulty injection into bowel wall
48	F	1.5	4 % in dist. water	4.5	21 days	0	+	One fine adhesion - omentum to small bowel
49	F	3.5	4 % in dist. water	10.5	21 days	0	0	Normal

+ mild; ++ moderate; +++ moderately severe; ++++ severe.

The general results of these experiments are condensed into the accompanying table. (Table II.) The degree of inflammation and the density of adhesions correspond to the condition found at necropsy.

Inflammatory Reaction to Sodium Ricinoleate. The degree of inflammation and the length of time that inflammation persisted was directly proportional to the concentration of sodium ricinoleate in distilled water. No evidence of inflammation was apparent after forty-eight hours when 0.25 per cent solution was employed; but it was apparent at the seventy-two hour examination when 2.0 per cent and 3.0 per cent solutions had been used. There was definitely more inflammatory reaction in the series injected with 2.0 per cent in normal injected with 2.0 per cent in distilled water. In none of the animals was the solution fatal, except in the cases in which injection was made into the wall of the bowel. These faulty injections occurred in early experiments. To determine if necrosis of the bowel wall occurred when sodium ricinoleate solution was introduced into the peritoneal cavity with the certainty that the solution was introduced into the peritoneal cavity and with the certainty that the solution was *not* injected into the bowel, a series of cases was studied in which the solutions were introduced through an incision made under aseptic technic. No deaths occurred in this group and at necropsy the bowel was found to be intact. This series is not included in the

results recorded in Table 1, because of inflammation of adhesions which might result from operative trauma.

Production of Adhesions by Sodium Ricinoleate. In all cases after the injection of sodium ricinoleate definite fibrinous exudate was found early, but the persistency of this exudate in the form of organized adhesions after the seventh day was very infrequent. Adhesions were not found in any of the animals later than seven days after being injected with concentrations of sodium ricinoleate of 2.0 per cent or less in distilled water. Very small strands were found in two cases in which the 3.0 per cent and 4.0 per cent concentrations were used. In only one case were adhesions encountered in which 2.0 per cent solution in normal saline was employed. Adhesions were found in the animal killed after seven days and in the one killed after twenty-one days following the injection of 2.0 per cent sodium ricinoleate in concentrated amniotic fluid.

The foregoing experiments indicate that sodium ricinoleate in concentrations from 0.25 to 4.0 per cent in distilled water, 2.0 per cent in normal saline and 2.0 per cent in concentrated amniotic fluid produces a definite inflammatory reaction in the peritoneal cavity which is nonfatal. In all experiments a fibrinous exudate was formed following injection which infrequently resulted in the formation of organized adhesions. While the series is small in which sodium ricinoleate in concentrated amniotic fluid was injected, adhesions were found more often in this series than in those in which distilled water or normal saline was used as a diluent.

Fig. 1. Appearance of the normal cecum of the adult rabbit.

Fig. 2. Appearance of the cecum of the adult rabbit soon after trauma.

STUDIES ON THE PERSISTENCE OF ADHESIONS AFTER TRAUMA TO THE CECUM OF THE RABBIT

Fifty adult rabbits were divided into five groups. Under sterile precautions and nembutal anesthesia, the abdomen was opened by an incision in the midline above the umbilicus. The entire cecum was traumatized by roughly pulling each segment through the fingers holding dry gauze. The abdomen was closed in two layers, chromic catgut being used in the peritoneum and muscles and linen in the skin, and a collodion dressing was applied. An additional dressing of three-inch stockinette was applied to the entire trunk, holes being cut for the legs. Ten control animals were untreated. Before closing the abdomen in the remaining animals, four groups of ten animals each received 20 cc. intraperitoneally, respectively, of 6.0 per cent gum acacia solution, 12.0 per cent gum acacia solution, concentrated amniotic fluid (Amfetin-Lilly) and 1.0 per cent sodium ricinoleate (Soricin-Merrell). The animals were killed and examined in each group after seven days. Cultures of the peritoneum were taken at the time of operation and at the time of examination. These were incubated on blood-agar media. All cultures were negative except that in

one animal the culture was positive at operation but negative at examination.

This method of producing adhesions was considered to be very drastic. After traumatizing the cecum there were generalized petechial hemorrhages and numerous subserous hemorrhages. (Figs. 1 and 2.) Adhesions resulting in control animals were dense and difficult to separate. (Figs. 2 and 3.) Adhesions were more apt to occur between the cecum and the parietal wall, due to the position of the animals and to the compression of the abdomen by the stockinette dressing.

Upon examination it was found that all adhesions existed in one or more of four sites; omentum to cecum or parietal wall, cecum to parietal wall, cecum to folds of cecum or cecum to other structures such as mesentery, loop of small bowel or the tip of the uterus or ovary. The results are condensed in Table III:

Table III

No. of Animals	Solution Used	Interval	Adhesions, Per Cent			
			Cecum-omentum	Cecum-parietal wall	Cecum-caecum	Cecum Elsewhere
10	Control	1 week	80	60	30	50
10	Amfetin	1 week	60	60	60	40
10	Acacia 6 per cent	1 week	40	60	10	10
10	Acacia 12 per cent	1 week	70	50	20	10
10	Soricin 1 per cent	1 week	30	20		

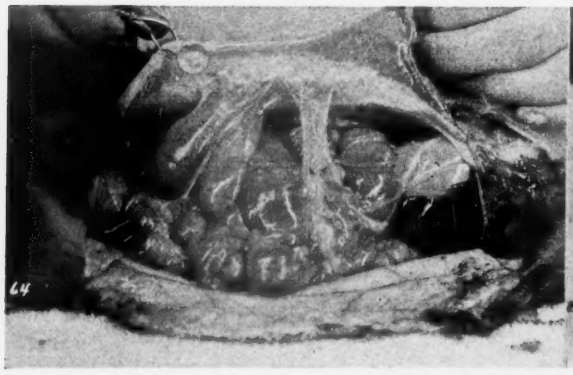

Fig. 3. Adhesions of the omentum and cecum to the line of incision and adjoining parietal wall seven days after trauma. (Control animal.)

Fig. 4. Adhesions of the cecum to the line of incision and adjoining parietal wall and adhesion between large bowel and cecum seven days after trauma. (Control animal.)

Gum acacia solution was used because it was hoped that some lubricating effect might be obtained if the solution remained within the peritoneal cavity. It has been found that gum acacia given intravenously persists within the circulatory system for many months. It was hoped that if acacia solution would remain on the circulatory side of the peritoneal cavity it would as well remain *without* the circulatory system if placed intraperitoneally. However, chemical tests of the peritoneal fluid after twenty-four hours failed to demonstrate the presence of acacia. Tests of blood serum were negative at the same interval. I am unable to say how this material was eliminated. However, since Auspitz[38] has demonstrated ground rice grains in the lung and spleen after intraperitoneal injection, it is not strange that acacia was removed.

The number of adhesions found after the use of amniotic fluid concentrate was almost as great as in the control group. Although this solution has been found to be stimulating to the peritoneum, it will be noted in the experiments of Seeley, Higgins and Mann[23] that this stimulation did not result in an appreciable increase of peritoneal fluid. Warren[29] states that amniotic fluid acts probably by reducing the oozing from injured surfaces. In the use of sodium ricinoleate there is a definite increase of peritoneal fluid. When we consider the scarcity of peritoneal adhesions in

tuberculous peritonitis with effusion it may be considered that exudation is of value in preventing adhesions. Further, in case of infection within the peritoneal cavity, absorption into the circulation is to be avoided. Sodium ricinoleate would not only tend to prevent absorption away from the peritoneal space, but to reverse this process by causing exudation of fluid and cells which are mixed with sodium ricinoleate known to be bactericidal, bacteriostatic and detoxifying.

The effects of sodium ricinoleate intraperitoneally may be summarized as follows: It causes an outpouring of exudate into the peritoneal cavity which is rich in neutrophils and monocytes, and from which is deposited dense fibrin. This furnishes fluid for lubrication, fibrin for healing, neutrophils for phagocytosis and lysis of fibrin and monocytes for regeneration of endothelium, thus imitating nature in the processes of primary healing. In case of infection, the presence of sodium ricinoleate further assists because of its bactericidal, bacteriostatic and detoxifying properties. Slowing or reversal of absorption from the peritoneal cavity is of additional value.

COMMENT

It should be emphasized that sodium ricinoleate solutions must be freshly prepared in pyrex glassware. I have found old stock solutions toxic, therefore, fresh stock should be used. Further, in an evaluation of adhesions in experimental work it is urged that very young animals and pregnant animals be avoided. I have noted that there is more peritoneal fluid in such animals, and adhesions are more difficult or impossible to produce even under control conditions. It is, therefore, obvious that an evaluation of substances designed to avoid unfavorable adhesions should be carried out in adult, nonpregnant animals. It should be further emphasized that any agent designed to prevent or reduce the number of adhesions must be introduced very early. Hertzler[1] states that coaptation of surfaces takes place within ten minutes and that for this reason the postoperative posture, movement of the patient or stimulation of peristalsis is unsuccessful on this account.

CONCLUSIONS

Healing of the peritoneum is exactly parallel with the formation of adhesions. Any measure designed to prevent unfavorable adhesions must imitate nature's methods of healing, not inhibit such processes. The most certain method of avoiding unfavorable adhesions is the limitation *only* of trauma to the area in which healing is desired. When there is trauma elsewhere, or when foreign bodies, infection, digestive juices or factors which alter coagulation are present, healing occurs at unfavorable sites, and nature's processes should be stimulated. In the studies reported in this paper stimulation of the peritoneum by sodium ricinoleate has been shown to imitate nature's processes of healing by the production of an abundant exudate which is rich in neutrophilic polymorphonuclear leucocytes and monocytes, from which abundant fibrin is desposited. The presence of this abundant exudate acts as a lubricant to prevent the formation of unfavorable adhesions.

In addition, sodium ricinoleate possesses bactericidal, bacteriostatic and detoxifying properties and by slowing or reversing absorption from the peritoneal cavity assists in combating infection. Sodium ricinoleate has been demonstrated to be well tolerated intraperitoneally in laboratory animals and in the human. It has been demonstrated that it is capable of preventing the majority of unfavorable adhesions after drastic trauma to the viscera and peritoneum of animals.

REFERENCES

1. Hertzler, A. E. The Peritoneum. Vol. 2. St. Louis, 1919. Mosby Co. Surgical Pathology of the Peritoneum. Philadelphia, 1935. Lippincott Co.
2. Opie, E. L. Inflammation. Harvey Lectures. Philadelphia, 1910. Lippincott Co.
3. Steinberg, B. A rapid method of protecting the peritoneum (by intraperitoneal injection of colon bacilli). *Arch. Surg.*, 24: 308–317, 1932.

4. Jones, D. F. and McClure, W. L. Practice of Surgery. Edited by Dean Lewis. Hagerstown, Md., W. F. Prior Co.
5. Norris, J. C. and Davison, T. C. Peritoneal reaction to liquid petrolatum, *J. A. M. A.*, 103: 1846–1847, 1934.
6. Marvel, E. Prevention of peritoneal adhesions by adrenal salt solution, with especial reference to the pelvis. *J. A. M. A.*, 49: 986–990, 1907.
7. Pope, S. The use of citrate solutions in the prevention of peritoneal adhesions. *Ann. Surg.*, 59: 101–106, 1914.
Pope, S. The prevention of peritoneal adhesions by the use of citrate solutions. *Ann. Surg.*, 63: 205–207, 1916.
8. Walker, W. H., Jr. and Ferguson, L. M. Peritoneal adhesions: their prevention with citrate solutions. *Ann. Surg.*, 63: 198–204, 1916.
9. Straus, D. C. Concerning the value of sodium citrate solution in the prevention of peritoneal adhesions. *Surg., Gynec. & Obst.*, 22: 602–609, 1916.
10. Sweet, J. E., Chaney, R. H. and Willson, H. L. The prevention of postoperative adhesions in the peritoneal cavity. *Ann. Surg.*, 61: 297–305, 1915.
11. Kubota, T. Experimental studies on the prevention of peritoneal adhesions. *Japan Med. World*, 2: 226–229, 1922.
12. Ochsner, A. and Mason, F. Prevention of peritoneal adhesions by the use of vegetable ferments. *Proc. Soc. Exp. Biol. & Med.*, 25: 524, 1928.
Ochsner, A. and Garside, E. Peritoneal adhesions. *Surg., Gynec. & Obst.*, 54: 338–361, 1932.
Ochsner, A. and Sterck, A. Prevention of peritoneal adhesions by papain; clinical study. *Ann. Surg.*, 104: 736–747, 1936.
13. Walton, J. P. Trypsin preparations suitable for prevention of abdominal adhesions. *J. Pharmacol. & Therap. Exp.*, 40: 403–411, 1930.
14. Yardumian, K. and Cooper, D. H. Pepsin in prevention of abdominal adhesions. *Arch. Surg.*, 29: 264–276, 1934.
15. Johnson, L. H. et al. Amniotic fluid concentrate as an activator of peritoneal immunity. *Surg., Gynec. & Obst.*, 62: 171–181, 1936.
16. Ochsner, A. and Garside, E. Peritoneal adhesions. *Surg., Gynec. & Obst.*, 54: 338–361, 1932.
17. Pfeiffer, R. and Issaeff. Quoted in Medical Research Council. A system of bacteriology. Vol. 6, Immunity, 1931.
18. Morton, H. B. Non-specific peritoneal immunization. *Surg., Gynec. & Obst.*, 52: 1093–1098, 1931.
19. Hermann, S. F. Experimental peritonitis and peritoneal immunity. *Arch. Surg.*, 18: 22–23, 1929.
20. Bargen, J. A. Peritoneal reactions to vaccine. *Proc. Staff Meet., Mayo Clin.*, 8: 581–582, 1933.
21. Judd, E. S. and Waldron, G. W. The prevention of surgical complications. *Wisconsin M. J.*, 34: 87–93, 1935.
22. Dixon, C. F. and Bargen, J. A. Vaccination preceding colonic operations as protection against peritonitis. *New York M. J.*, 35: 1–4, 1935.
23. Seeley, S. F., Higgins, G. M. and Mann, F. C. Studies on peritonitis: the cytologic response of the peritoneal fluid to certain substances. *Proc. Staff. Meet., Mayo Clin.*, 10: 793–796, 1935.
24. Corwin, W. C. The peritoneal cytolic response; an experimental study. *Am. J. Med. Sc.*, 193: 251, 1937.
25. Wangensteen, O. H. Personal communication, April, 1937.
26. Gillette, N. W. The avoidance and treatment of peritonitis. *J. Med. Prac.*, 89–92, 1936.
27. Wangensteen, O. H. High gastric resection in cancer of the stomach with relation of personal experiences. *Journal-Lancet*, 57: 1–4, 1937.
28. Johnson, H. L. Observations on the prevention of post-operative peritonitis and adhesions. *Surg., Gynec. & Obst.*, 45: 612–619, 1927.
Johnson, H. L. Amniotic fluid concentrate in the prevention of adhesions. *New England M. J.*, 199: 661–664, 1928.
Johnson, H. L. Amfetin: its influence upon defense and repair in serous cavities. *Med. Arts.*, 36: 409–413, 1933.
29. Warren, S. The effects of amniotic fluid on serous surfaces. *Arch. Patbol.*, 6: 860–866, 1928.
30. Trusler, H. M. Peritonitis: An experimental study of healing in the peritoneum and the therapeutic effect of amniotic fluid concentrate. *Proc. Staff. Meet., Mayo Clin.*, 4: 356, 1929.
Trusler, H. M. Experimental study of healing in the peritoneum and the therapeutic effect of amniotic fluid concentrate. *Arch. Surg.*, 22: 983–992, 1931.
31. Kimpton, A. R. Amniotic fluid concentrate (amfetin): post-operative use to stimulate peritoneal defense and repair; report of case of multiple laparotomies. *New England M. J.*, 207: 465–467, 1932.
32. Rea, C. E. and Wangensteen, O. H. Comparative efficacy of substances employed in the prevention of peritoneal adhesions. *Proc. Soc. Exper. Biol. & Med.*, 31: 1060–1063, 1934.
33. Lacey, J. T. The prevention of peritoneal adhesions by amniotic fluid. *Ann. Surg.*, 92: 281–293, 1930.
Lacey, J. T. Amniotic fluid: clinical study (using amniotic fluid in experimental studies on post-operative conditions) *Ann. Surg.*, 101: 529–535, 1935.
34. Gepfert, J. R. Intraperitoneal use of amniotic fluid (amfetin) to promote smoother post-operative convalescence. *Am. J. Surg.*, 32: 40–44, 1936.
35. Larson, W. P. and Halverson, H. O. The effect of concentration upon the neutralization of toxin by sodium ricinoleate. *Proc. Soc. Exper. Biol. & Med.*, 22: 550, 1925.
Larson, W. P., Halverson, H. O., Evans, R. D. and Green, R. G. The effect of surface tension depressants upon bacterial toxins. Colloid Sympos. Monograph, 3: 152–157, 1925.
Larson, W. P. and Nelson, E. The effect of the surface tension on the medium upon bacterial growth. *Proc. Soc. Exper. Biol. & Med.* 21: 278–279, 1924.
36. Rea, Charles E. Personal communication, October 15, 1940.
37. Rider, T. H. Unpublished data.
38. Auspitz, H. Über die bebedeutung der lymphroege fur die resorption kleiner flussigkeitswengen aus der bauchhuhle. *Centralbl. f. Physiol.*, 10: 219, 1896.

ABDOMINAL ANEURYSM

A REPORT OF TWENTY-FOUR CASES

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IT is the purpose of the authors to report this series of twenty-four cases of aneurysm occurring in the Philadelphia General Hospital in the last ten years, 1930 to 1940. During this period there were approximately 200,000 admissions to this institution, so that the condition is probably encountered here with more than average frequency. Our main endeavor will be to discuss what these cases offer us that may be particularly helpful toward making an early diagnosis.

Although abdominal aneurysm was first mentioned in the literature nearly 450 years ago, Kampmeier, writing in 1936, could find only 386 cases recorded in the literature and apparently little of diagnostic interest was presented during this period to justify much consideration being given the subject in our textbooks of today. Perusal of several of the most widely known texts reveals the fact that but a short paragraph is given to such discussion in any of them. This paucity of expression seems to us to justify any and every contribution that these twenty-four case reports may have to offer.

TABLE I
AGE INCIDENCE

Age	No. of Cases	Percentage
30–40	6	25.
41–50	5	20.8
51–60	8	33.3
61–70	3	12.5
71–80	1	4.1
80-up	1	4.1

Lowest age—33
Highest age—83
Average age—51

As shown in Table 1, 79.1 per cent of the cases in this series of twenty-four occurred in patients between the ages of thirty and sixty, and about one-third (33.3 per cent) occurred between fifty-one and sixty years. There was a predominance in males, the ratio being approximately 5:1. In other earlier reported series this ratio has reached as high as 9:1 (Nixon). Distribution as regards race was about equal.

TABLE II
SEX INCIDENCE

Sex	No. of Cases	Percentage
Male white 12 black 8.....	20	83.3
Female white 2 black 2.....	4	16.7

TABLE III
WASSERMANN REACTION
The Reaction Was Reported in Twenty-one Cases; No Report on Three Cases

Age	Positive	Negative	No Report
30–40	4	2	0
41–50	3	2	0
51–60	3	3	2
61–70	0	2	1
71–80	0	1	0
81-up	0	1	0
	10	11	3

We found that the Wassermann reaction was not reliable as to etiology of this condition since a negative Wassermann test was obtained in one case with definite findings at necropsy of a syphilitic aneurysm; and

in another case a positive Wassermann reaction was obtained in which evidence substantiated the diagnosis of an arteriosclerotic aneurysm. (Table III.)

Despite these two fallacies we note that only ten of the reported cases had syphilis and the other half had to have some other causative factor for the arteriosclerosis producing the aortic degeneration. In none of our cases was trauma given as an etiological factor.

Table IV

Differential Diagnoses	No. of Cases
Abdominal aneurysm	12
Hypernephroma	5
Mesenteric thrombosis	4
Coronary occlusion	4
Retroperitoneal tumor	2
Pancreatitis	2
Gastric carcinoma	2
Appendicitis	2
Pott's disease with abscess	2
Nephrolithiasis	2

The differential diagnoses (Table IV) made during the course of the study of these cases were many, there being a total of fifty-two in the twenty-four cases. This table shows the number of diagnoses that occurred two or more times. In addition to these there were forty-two other single erroneous diagnoses. This high percentage of failure should be embarrassing to our hospital staff in this age of laboratory aids, particularly the roentgenogram, not mentioning the much older stethoscope. Actually, a correct diagnosis was made in just twelve of the patients, and in eight more a vascular lesion was the diagnosis. It will be noted also that in this series the total number of diagnoses was eighty-nine.

This list of diagnoses is given to illustrate how far afield one can wander in abdominal diagnosis, particularly when the symptoms and signs are in the left portion of the abdomen and especially the upper left quadrant. When we recall that fully 75 to 80 per cent of abdominal surgical lesions are midline or on the right, it simply means that we are not having our diagnostic acumen sharpened enough by the repetition of left-sided lesions.

Table V

Symptom	No. of Cases
Symptoms in order of their frequency:	
Pain	23
Constipation	8
Dyspnea	6
Vomiting	6
Leg edema	5
Weight loss	3
Dizziness	2
Mass in epigastrium	1 each
Jumpy heart beat	1 each
Weakness in leg	1 each
Swelling in one leg	1 each
Pain in leg	1 each
Anorexia	1 each
Nocturnal dyspnea	1 each
Staggering	1 each
Nocturia	1 each
Hematemesis (massive)	1 each
Melena	1 each

The most common symptom was pain, present in twenty-three of the patients. The character of the pain varied from mild backache to the severe pain of a dissecting aneurysm which was unrelieved by large doses of morphia. It was described as a throbbing, pulsating pain in one case. The duration of the pain was also variable. One patient had pain only a few hours prior to admission while another had pain for four years. Here again the diagnostician is confronted with a difficulty in analyzing the pain. However, the fact that in only two of the cases was there any mention made of symptoms related to the digestive tract, vomiting in one and hemorrhage in the other, should narrow the field of mistakes. The complaint of constipation by eight of the patients represents but little increase of this condition in the average admission to any hospital. Pain radiating into the back, the groin, left testicle and down the left leg, is mentioned by several writers.

The origin of the pain was in the lumbar region in nine cases, abdominal in fourteen, and in the loin (left) in one case. There was radiation of the pain to the left groin, left testicle, and down the left leg in nine cases. Of these nine cases, 6 showed erosion of the vertebrae by roentgenogram, two showed no erosion and in the remaining one no roentgenogram of the vertebrae was taken.

The roentgenogram was employed in sixteen of the cases of which eleven showed erosion of the vertebrae and five, or 31 per cent, were reported negative. Several of the symptoms as dyspnea, leg edema, dizziness and nocturia were attributed to heart disease. One patient in the group had very little pain. The prominent symptom was massive hematemesis produced by rupture of an aneurysm of the celiac axis into the jejunum. Death occurred twenty-four hours after the onset of hemorrhage. When one reviews the above picture he finds such a varied, complex and bizarre collection of signs and symptoms which may have connection with pressure upon viscera and large vessels supplying such viscera as the kidneys, the liver, intestines, stomach, lower extremities, etc., that he must of necessity be reminded at least of not only the possibility but the probability of the existence of an aneurysm as the causative factor.

TABLE VI
BASIS FOR DIAGNOSIS

	No. of Cases	Percentage
Presence of pulsating mass	13	54.1
Erosion of vertebrae by roentgenogram	3	12.5
Postmortem findings	4	16.7
History of previous laparotomy	1	4.1
Laparotomy	1	4.1
Severe abdominal pain; absence of arterial pulsations in lower extremities	1	4.1
Sudden severe pain; shock	1	4.1

A positive statement as to the existence of a bruit or thrill was obtained in only five cases; in the remaining nineteen cases, no mention of a bruit was made. The most reliable finding upon which the diagnosis was based (Table VI) was the presence of a pulsating mass, demonstrated in thirteen cases (54.1 per cent). Of these thirteen cases the mass was definitely expansile in five cases. The relative infrequency of the findings of bruit and thrill may readily be attributed to clotting in the sac rather than to careless physical examination. Aneurysms in the more superficial parts of the body are diagnosed earlier when bruit, thrill and expansile pulsation are easily recognized. There were two cases diagnosed by roentgenogram (erosion of vertebrae) and four diagnosed only at necropsy (abdominal aneurysm was not suspected in the last four cases). Farmer, in 1927, makes the statement that "a soft tissue mass may be seen by the roentgenologist but it must have calcified laminae in its substance to arouse strong suspicion of abdominal aneurysm." One case had a laparotomy thirteen months prior to admission and was diagnosed as abdominal aneurysm. One, diagnosed at laparotomy was suspected to have an intestinal obstruction. The case diagnosed because of severe pain and absent pulses in the lower extremities was one of a dissecting aneurysm of the aortic arch which dissected down the aorta and its branches occluding all the branches (including both renal and common iliac arteries). One case was diagnosed dissecting aneurysm because of sudden severe abdominal pain and shock in a patient with a mass in the left lumbar region. A roentgenogram in this case showed erosion of the vertebrae.

The blood pressure in these cases ranged from 60 to 250 sytolic and 40 to 160 diastolic. Ten cases had systolic pressure under 120, and fourteen had pressure over 120.

In the twenty-four cases cited, the diagnosis in twenty was confirmed by postmortem examination or by exploratory laparotomy. Of the sixteen cases that had postmortem examination, ten showed a rupture of the aneurysm, nine being retroperitoneal and one into the jejunum. Of the eight without a postmortem study, two showed clinical evidence of rupture. The diagnosis in the remaining four was confirmed by the presence of a pulsating abdominal mass and evidence by roentgenogram of erosion of the vertebrae. Six patients left the hospital, three of whom had been operated upon.

TREATMENT

Exploratory laparotomy was done in seven cases. Reparative work directed toward the aneurysm was done in five cases, three of which were wired, ligation of the left common iliac artery for ten days in one case and an attempted arteriovenous anastomosis between the iliac vessels in one case.

SUMMARY

Twenty-four cases of abdominal aneurysm have been reported.

The etiology has been discussed with especial reference to the Wassermann test.

A study of the symptomatology and the differential diagnosis has been made with emphasis laid upon the frequency of error.

A pulsating mass was found to be the most frequent diagnostic symptom, while bruit and thrill were noted in only five cases.

The diagnosis was confirmed in twenty of the cases by postmortem or laparotomy.

The authors wish to express their appreciation to the various members of the Staff of the Philadelphia General Hospital for permitting the use of their case records in this review.

REFERENCES

Nixon, J. A. *St. Barth. Hosp. Rep.*, 27: 43, 1911.
Kampmeier, R. H. *Am. J. Med. Sc.*, 192: 97, 1936.
Farmer, H. L. *Am. J. Roentgenol.*, 18: 550, 1927.

Ever since the classic report of van den Velden more than sixty years ago it has been repeatedly shown that achlorhydria and hypochlorhydria characterize the gastric secretory status of the majority of patients with gastric carcinoma.

From—"Carcinoma and Other Malignant Lesions of the Stomach"—by Waltman Walters, Howard K. Gray and James T. Priestley (W. B. Saunders Company).

PEMPHIGUS VULGARIS OF THE URINARY BLADDER*

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PEMPHIGUS vulgaris of the gastrointestinal tract is not uncommon, but pemphigus of the urinary bladder is very rare and is seldom diagnosed before postmortem examination.

The following case report is of interest in that the patient presented pemphigus vulgaris of the urinary bladder as well as the cutaneous surface and the gastrointestinal tract. The clinical diagnosis of pemphigus of the urinary bladder was confirmed by cystoscopy and definitely proved by histopathological examination of portions of the organs obtained at necropsy seven days after the cystoscopic examination.

CASE REPORT

M. F., a white, married Jewish woman, forty-three years of age, was admitted to the Post-Graduate Hospital on August 19, 1940. Seven weeks previous to her admission she noticed a vesiculobullous eruption on her arms, which spread within a week to her neck, face, shoulders, forearms and wrists. Three weeks before we admitted her, the patient was in a hospital in New Brunswick, New Jersey, for seventeen days where she received a course of sulfanilimide during which the blood sulfanilimide level was maintained at 7 to 8 mg. per 100 cc. for several days, and vitamin D in daily doses of 100,000 units for one week. Despite these therapeutic measures, the eruption became more extensive.

On admission to Post-Graduate Hospital the patient presented a generalized cutaneous bullous eruption which was diagnosed clinically as pemphigus vulgaris with acute and subacute eczematous manifestations. The Nikolsky phenomena could be elicited in all supposedly normal skin areas. There was a painless, pea-sized flaccid bullous lesion on the right tonsil. The external genitalia were free of the eruption. A blood count revealed a moderate secondary anemia, and a moderate polymorphonuclear leucocytosis. There was slight stippling and anisocytosis of the red blood cells, and a few slightly toxic leucocytes.

Urine analysis showed a dark amber, acid urine, with a specific gravity of 1.020. There were 2 to 4 red blood cells, 1 to 3 white blood cells per HPF, and a faint trace of protein. A few round cells, many squamous cells (some in clumps), many bacteria, and a few yeast cells were observed. The temperature was 101.2°F., pulse 130 and respirations 24 per minute.

On August 22, the patient noticed some difficulty in voiding but on the twenty-third, twenty-fourth and twenty-fifth she voided normally. Similar symptoms were again noted on the twenty-sixth, twenty-seventh and twenty-eighth when she was seen in consultation with the genitourinary surgeon. A sterile catheterized specimen of urine was obtained for analysis and culture. The urine was dark brown in color, very cloudy, and foul smelling, alkaline in reaction, with a specific gravity of 1.010. There was a trace of acetone, and 2 plus protein. Ten to 15 white blood cells per HPF with a few large clumps of pus cells were found; no blood cells were noted, but a 4 plus benzidine reaction for occult blood was present. On culture, the urine showed Bacillus coli and nonhemolytic streptococci, but Staphylococcus aureus was recovered from the blood on culture.

On August 26, the icteric index, urea N, serum chlorides, true glucose, and cholesterol were normal. The total proteins were 4.2 per cent with albumen 1.8 per cent and globulin 2.4 per cent and an albumen-globulin ratio of 0.75.

On August 28 and 29 the patient voided freely, but on the following day there was considerable difficulty which subsided on August 31. On September 1 and 2 she developed nocturnal urinary incontinence.

On September 3 a cystourethroscopic examination revealed the following: With local

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anesthesia of the urethral mucosa only, a No. 24 F panendoscope was introduced into the bladder without difficulty. Foul-smelling, thick brownish urine was obtained. The bladder capacity was good and the patient evinced practically no pain or discomfort throughout the examination, even on overdistention of the bladder. A considerable amount of flaky white and grey débris was noted in the medium. In the posterior upper portion of the viscus, the normal mucosa appeared injected. On the posterior base and lateral walls it was hemorrhagic. The left anterior and lateral portions were markedly inflamed with dark, reddish-brown erosions and ulcerations interspaced with areas of bullous edema. Adherent membranous mucopurulent material was widely distributed over the inflamed portions of the bladder. The right ureteral orifice appeared normal. The left could not be observed owing to the inflamed, thickened mucosa and membranous material covering the left bladder floor. The internal vesical sphincter was normal in contour and appearance and was not elevated. The floor of the proximal portion of the urethra showed a dark, reddish-brown discoloration. A mushroom catheter was inserted and tidal irrigation instituted.

A diagnostic film on this date showed no abnormality of the urinary tract, but the lumbar spine showed a marked rotation and right lateral curvature. On September, 3 and 5 the urea nitrogen, uric acid, creatinine and carbon dioxide combining power were within normal limits. The serum chlorides, true glucose and total calcium were normal on September 6.

Despite the use of germanin, sodium sulfapyridine, sulfapyridine, blood transfusions, daily infusions of glucose in saline and other methods of supportive therapy, the patient expired on September 10. Throughout the course in the hospital the patient's temperature was septic, fluctuating between 98° and 104.4°F. daily. There was always a concomitant elevation of the pulse rate. The temperature rose to 106.4°F. on September 9, but returned to 103°F. before death.

Necropsy Report. The skin was dry and scaly in texture and almost completely covered by numerous small crusted lesions, up to 2 cm. in diameter. The lesions were most prominent on the face, ears, chest, buttocks and extremities. A large decubitus ulcer, 6 cm. in diameter was noted over the sacral promontory. On histological study the rete pegs were slightly shortened and thickened, and the basal layer of the epidermis vesiculated and slightly edematous. The papillae were narrowed and flattened,

Fig. 1. Kidney, ureter and bladder—showing evidence of pemphigus vulgaris in the bladder.

the intercellular bridges of the prickle cells of the epidermis unusually prominent. Many of the papillae were edematous, and the blood vessels in the upper portion of the dermis were surrounded by a moderate number of lymphocytes, polymorphonuclear leucocytes and plasma cells.

A few small atheromatous plaques were seen on the intimal surface of the ascending portion of the aorta. The apices of the upper lobes of the lungs were grey, contracted and fibrosed with the visceral pleura over these areas firmly attached by fibrous adhesions, to the adjacent parietal pleura. The right, middle and lower lobes were crepitant throughout. The lungs revealed chronic passive congestion of the lower lobes and bilateral, healed apical lesions.

The spleen and adrenals were normal, and the liver showed evidence of chronic passive congestion. The cut surface of the cortex and

medulla of the kidneys was congested, and the demarcation between them indistinct. (Fig. 1.)

The genital tract was essentially negative. The urinary bladder was normal in size. The serosal surface was smooth, pink and glistening; and on section, the wall was uniformly 3 to 4 mm. thick. The bladder contained about 30 cc. of foul-smelling, cloudy, yellow urine. The mucosal surface was markedly engorged and studied with numerous discrete, irregularly round, yellow, partially necrotic plaques, up to 15 mm. in diameter. These lesions were not found over the surface of the markedly engorged trigone, nor did they involve the mouths or distal portions of the ureters. The urethra was patent and had a red, congested epithelial lining.

The wall of the esophagus was uniformly 3 mm. thick, the mucosa was moderately hemorrhagic. The stratified squamous epithelium was missing for the most part, and where it remained, was poorly preserved. The mucosa was covered with a thin layer of fibrin, desquamated epithelial cells, red blood cells, lymphocytes and débris, and was engorged and sprinkled with polymorphonuclear leucocytes and lymphocytes; the muscularis mucosa was fragmented and many of the muscle fibers were hyalinized. The submucosa, muscle and subserosal layers were edematous and had numerous congested blood vessels. The stomach contained about 100 cc. of brown, turbid fluid. The mucosa was grey and bile-stained. The duodenum was unaltered; the small intestine contained about 100 cc. of yellow chyme. On the mucosa, on the posterior wall of the cecum, there was an elevated, irregularly round, partially necrotic plaque, 2 cm. in diameter, similar to those described in the urinary bladder. The mucosa of the cecum was poorly preserved and the epithelial layer had disappeared. The villi were markedly engorged and infiltrated with polymorphonuclear leucocytes and lymphocytes. A few of the smaller blood vessels were filled with organizing thrombi. The submucosa was markedly edematous and sprinkled with polymorphonuclear leucocytes and lymphocytes. The muscle and subserosal layers were edematous.

DISCUSSION

A review of the American Literature from 1890 to 1940 reveals no observations pertaining to pemphigus vulgaris of the urinary bladder. The first recorded case of chronic pemphigus vulgaris in which the urinary bladder was primarily involved is that of von Ludwig in 1897. In 1904, Schild cited a similar instance of pemphigus vulgaris with involvement of the urinary bladder. Fabry, in 1904, reported a case of pemphigus foliaceus in which he suspected involvement of the urinary bladder because of the presence of blood in the urine. Bernhard, in 1902, described bladder involvement in a case of pemphigus vegetans. Von Purgesz, von Rayer, and Scholus, each reported bladder involvement in cases of chronic pemphigus vulgaris, making a total of seven cases. We do not believe that this condition is as rare as these figures would imply and are of the opinion that prompt cystoscopic investigation of symptoms referable to the urinary bladder will reveal many cases that would be otherwise unrecognized.

The presence of urinary disturbance with hematuria and pyuria in the course of pemphigus vulgaris should direct attention to possible involvement of the bladder. The cystoscopic determination of its presence under these circumstances presents no great difficulty. However, where it is primary to the bladder or urethra, as in von Ludwig's case, the findings may be misinterpreted unless the cystoscopist is on the alert.

In the earlier and intermediate stages, before infection has changed the picture, the characteristic bullae are helpful. When inflammation has advanced to the stage where the earlier lesions are obscured and supplanted by bullous edema, erosions, ulcerations with adherent membranous débris, an appearance is presented which no longer is typical of pemphigus vulgaris, but suggests a profound inflammation of the viscus with probable invasion of the bladder wall such as is seen in tuberculosis and other serious invasions of the bladder.

The absence of reduced bladder capacity, pain and discomfort on cystoscopic examination in the presence of profound inflammatory change noted in this patient appears

worthy of comment. The limited literature on this subject fails to reveal any mention of the syndrome, which, if substantiated by similar findings in other cases of pemphigus vulgaris, will prove valuable both in the diagnosis and differentiation of the vesical form of this disease.

CONCLUSIONS

1. The recorded cases of pemphigus vulgaris of the urinary bladder are extremely rare. The condition is seldom diagnosed before necropsy.

2. Prompt investigation of bladder manifestations will reveal many cases of vesical involvement.

3. A review of both the American and foreign literature from 1890 to 1940 reveals no observation in the former and only seven recorded cases in the latter.

4. This, the eighth published case, is of interest in that the clinical diagnosis was made by urethrocystoscopy and confirmed by postmortem examination.

5. The profound inflammatory change in the bladder mucosa with excellent tolerance on instrumentation noted in this case is worthy of comment.

REFERENCES

Bernhard, Carl. Ein Fall von Pemphigus vegetand mit bezonderer Berucksichtigung der Histologie. Inaug., Diss. Freiburg i. Br. 1902.

Fabry, J. Beitrag zur Klinik und Pathologie des Pemphigus foliaceous. *Arch. f. Dermat. u. Syph.* 70: 183, 1904.

Julinsberg, F. and Riecke, E. Handbuch der Haut und Geschlects Krankeiten. Vol. VII/2.

Scholer. Dem Pemphigus conjunctivae. Verhandl. d. Berl. Med. Gesellsch., 21. Juni 1882. Ref. *Klin. Wchnschr.*, p. 735, 1882.

Schild, W. Ein Fall von Pemphigus vulgaris mit Affektion der Harnblasen-Schleimhaut. *Internat. dermat. Kong. Verhandl. u. Ber.*, 1904, Berl., 1905, II, pt. 2, 450.

THE DIAGNOSIS OF TORSION OF THE PEDICLE OF AN OVARIAN CYST*

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TORSION of the pedicle of an ovarian cyst is an acute abdominal emergency, the diagnosis of which can be made in a great majority of cases. Although the condition is not seen with great frequency, it occurs with sufficient regularity to demand that its possibility be constantly kept in mind by the operating surgeon. Twisted ovarian cyst has been a known clinical entity for at least seventy-five years, but there have been few publications on the subject during the last decade.

Torsion of the pedicle of an ovarian cyst may occur at any age but it is seen during the second, third, and fourth decades most commonly. Reuben[20] collected ninety-nine cases in children, and Haines and Edgerly[8] found thirteen cases in girls under seven years of age. These authors emphasize the necessity of considering this condition in surgical emergencies in children. Robins[18] has reported a case in a woman seventy-seven years old, and this report includes a patient of eighty-seven years and one of seventy; hence the condition should even be considered by the specialist in geriatrics when an acute abdominal emergency appears in the aged.

It is difficult to estimate how frequently the pedicle of an ovarian cyst undergoes torsion. Grotenfeldt[7] has tabulated the experience of a group of thirty-six surgeons concerning the frequency that torsion is found in operations for ovarian cyst. The frequency varied from 2 to 47 per cent. It is certainly apparent that it is difficult to estimate its frequency, and the review of a single institution's or surgeon's experience with ovarian cysts gives an erroneous conception of the frequency, as many simple cysts cause such slight symptoms that medical care is never sought, while when torsion occurs, the severe symptoms almost invariably necessitate hospitalization.

TORSION OF OVARIAN CYSTS
Incidence by Age Groups

Age Group Years	No. of Patients
10–15	2 (11) (14)
15–20	6
20–25	9
25–30	9
30–35	9
35–40	11
40–45	7
45–50	4
50–55	8
55–60	1
Over 50	3 (65) (70) (87)

The records of sixty-nine patients with torsion of the pedicle of an ovarian cyst who were operated upon at Cook County Hospital during the sixteen-year period 1925 to 1940 are reviewed in this paper.

Etiology. The exact cause of torsion of the pedicle can be ascertained but rarely. The early publications contained much speculation on the subject. Payr[15] thought that increased venous congestion tended to cause torsion while Jolly[10] believed that the expansile force of the growing tumor in some cases tended to increase the frequency of torsion. Certain predisposing factors are known, with reasonable certainty, to exist in the production of torsion. Smooth, free cysts of small to moderate size on a long, thin pedicle undergo torsion most commonly. Frank,[4] Bernstein[3] and others have found that solid tumors undergo torsion more frequently than cystic tumors.

Changes in intra-abdominal pressure seem to initiate torsion in some cases; this may account for cases seen during preg-

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nancy or the puerperium. In this series seven patients (10 per cent of the series) were operated upon during pregnancy or during the first six months of the puerperium. In addition, several cases not included in this report were seen with symptoms suggesting ovarian torsion associated with pregnancy. These patients were not operated upon as their symptoms tended to subside.

Occasionally, trauma is associated with the initial symptoms of ovarian torsion. In three patients (4.2 per cent) in this series the onset was dated from an injury or some unusual strain. In one the patient first complained after striking her abdomen on a wash tub; one dated her symptoms from a sudden turn in bed while the final patient first experienced pain after an unusual reach. The traumatic and medicolegal aspects of ovarian torsion are discussed in the excellent paper by Sneierson, Schlesinger and Gold.[22]

Pathology. There may be any number of turns of the pedicle of an ovarian cyst from one-half turn to twenty-five. In some cases a rotation of 180° may be sufficient to affect the blood supply; while in others numerous turns do not impair the circulation at all. Rotation usually occurs in a clockwise direction on the right side and in a counter-clockwise direction on the left. This is known as Küstner's law[12] and is said to be true in 85 per cent of cases (Pfannensteil).[16] Retorsion or spontaneous restitution occasionally occurs; Grotenfeldt[7] collected seven cases in the literature and added six more cases seen by himself.

The type and extent of the pathological changes depend on the degree of vascular impairment produced by the torsion. A moderate twist may be sufficient to obstruct the venous return but not affect the arterial supply. This causes congestion and in some cases produces hemorrhage into the cyst. Because of the anastamosis between the ovarian and uterine veins in the broad ligament, there is also congestion and edema of the uterus, tube, and broad ligament although to a less extent. Progressive hemorrhage into the cyst may continue to such an extent that rupture occurs. In this case symptoms closely simulating rupture of an ectopic pregnancy may ensue. Occasionally, the hemorrhagic cyst may become infected from the nearby bowel. When torsion is sufficiently marked to obstruct the arterial supply, necrosis, gangrene and subsequent infection usually occur. In some cases calcification is the end result. The advent of marked torsion produces the particularly severe symptom complex.

Torsion of practically every type of ovarian tumor has been reported in the literature. One case reported in this series on pathological examination appeared to be strangulated normal ovarian tissue. This is a rather rare condition which has been discussed by Barron.[2] In this series 69 per cent were grouped in the category of simple ovarian cysts (Gardiner's classification).[5] This includes follicular cysts, corpus luteum and hemorrhagic cysts. The pathological findings of the cysts in this series are tabulated below:

TWISTED CYSTS FOUND IN THIS SERIES
(Gardiner's Classification)[5]

Group I—Simple Retention Cysts	
A—Follicular cysts	30
B—Hemorrhagic cysts	6
Group II—Endometrial Cysts	2 (chocolate cyst)
Group III—Neoplastic Growths	
A—Epithelial growths	
1. Pseudomucinous cystadenoma	2
2. Papillary cystadenoma	3
3. Carcinoma	1
B—Embryoma	
1. Dermoids	7
C—Connective tissue tumors	
Group IV—Inflammatory Cysts	2
Parovarian cyst	1
Interligamentous cyst	3
No report	11

Clinical Manifestations. Abdominal pain, the most common complaint, was present in sixty-eight patients (98.5 per cent). It was the presenting symptom in sixty-six cases (95.6 per cent). In most cases the pain was described as sharp or cramping and was considered severe in sixty-four patients (92.7 per cent). The pain was usually located in the lower abdomen and in most cases localized to the

affected side. The pain radiated to the back in sixteen cases (23.1 per cent) and to the anterior and lateral aspect of the thigh on the involved side in eleven cases (15.9 per cent). Radiation down the thigh is significant when present and is accurate in determining the side of the lesion; the diagnostic value of this finding has been emphasized by Koucky.[11] In this connection one case in this series is of particular interest. This is a case of bilateral torsion of ovarian cysts, an uncommon occurrence which has previously been described in case reports by Armstrong[1] and Prichard.[17] On one side torsion had advanced to the point of strangulation of the cyst; on the other side, although torsion was present, there was no evidence that the blood supply was impaired. This patient had characteristic radiation of pain down the anterior and lateral aspect of the thigh on the side of the strangulated cyst. This radiation probably occurs through the second lumbar nerve which supplies the pelvic organs and the anterior and lateral aspect of the thigh.

Nausea and vomiting were usually present and occurred following the abdominal pain. The vomiting was not complete or unusually protracted in any case. This finding was present in forty-eight cases (69.5 per cent).

No characteristic menstrual disturbance was found in this series. Of sixty-seven patients with adequate menstrual histories fifty-seven (85 per cent) associated no change in their menses with their symptoms. Thirty-five (52.2 per cent) gave a history of regular periods; twelve (17.9 per cent) were past the menopause; four (5.6 per cent) were pregnant; one had been pregnant but had had an induced abortion a short time before, and one was in the prepuberal stage. Of ten patients (15 per cent) who had noticed menstrual irregularities beginning at the same time or before the symptoms of torsion, three had amenorrhea; three had metrorrhagia; two noticed delay in onset of periods; one had scant flow, and one had early onset of periods.

Abdominal tenderness was present in a large majority of the cases and was usually localized over the site of the lesion, although in some cases it was generalized. It was present in sixty-three patients (91.3 per cent). Abdominal rigidity was found in nineteen patients (27.2 per cent). This finding indicated in most cases that the blood supply of the ovary was severely compromised or that rupture or hemorrhage had occurred.

A palpable mass was present on either abdominal or pelvic examination in fifty-eight patients (84 per cent). In three cases in which no mass was found, pelvic examination was not done; while in three other patients, abdominal rigidity was sufficiently marked to make palpation of a mass impossible.

Most of the patients had a low grade fever and a moderate acceleration of the pulse rate. Occasionally, the fever was found to be as high as 102°F. (38.8°C.) or more, but usually it was between 99°F. (37.2°C.) and 100°F. (38.8°C.). Fifty-five patients (79.8 per cent) had a fever of 99°F. or over (37.2°C.) on admission while forty-seven (68.1 per cent) had a pulse rate of 90 beats per minute or more. The leucocyte count was over 10,000 per cubic mm. in 76 per cent of the patients in which this procedure was done.

Fifty-nine (85.5 per cent) of these patients had borne children while ten (14.5 per cent) were nulliparous. Torsion occurred on the right in 60.8 per cent and on the left in 39.2 per cent. All of these patients had the twisted cyst removed at operation; several had salpingectomy at the same time, while in a few a hysterectomy was also done. In one patient a cesarean section was done in addition to oophorectomy. Most of the patients were hospitalized for twenty-one days or less; fifty-six (81 per cent) were discharged in twenty-one days or less while forty (58 per cent) were discharged in fifteen days or less.

Diagnosis. The palpation of a mass connected with the uterine adnexia is vital in establishing a diagnosis of twisted ovarian cyst. In this series a mass was

palpated in 84 per cent of the patients. Of eleven patients in which no mass was found, three did not have pelvic examinations, and in three rigidity of the abdominal muscles prevented a satisfactory bimanual examination. From these figures it is reasonable to conclude that a mass will be found in practically every instance if a careful examination is done. Examination under anesthesia should be used in every case in which the ordinary pelvic examination is unsatisfactory.

The following is a simulated history of a typical patient with torsion of the pedicle of an ovarian cyst:

A thirty-year old multipara who has been feeling perfectly well previously is suddenly seized with a sharp, severe cramping pain in the lower portion of the abdomen. This pain is present in her entire lower abdomen but is more severe on the right side. The pain is so severe that she is forced to stop her housework and go to bed. Shortly after going to bed she suddenly feels nauseated and vomits. The pain persists while she is in bed and even seems gradually to become somewhat more intense. She recalls having had a similar but milder attack two months previously which gradually passed off. About four hours after the onset she eats a light lunch but becomes nauseated about one-half hour after eating and vomits. The pain still remains in the same location and its character has not altered. She has no other complaints. Her bowel movements have been normal and her periods regular. She experiences no difficulty voiding; in fact there seems to be a brief but noticeable decrease in her pain following urination.

As the pain seems to have become somewhat more severe, the patient summons her physician; approximately twelve hours have elapsed since the onset. He finds the patient to be a well developed and nourished female whose temperature is 99.6°F. (37.6°C.); her pulse rate is 96 beats per minute, and her respirations are 20 per minute. The head, neck, chest and extremities show no abnormality. Her abdomen is soft and relaxed. On examination with a stethoscope the peristaltic sounds are found to be of normal frequency and intensity. There is tenderness over the entire lower portion of the abdomen, but it is most marked low in the right lower quadrant. A mass can be palpated in this region; it is about the size of a small orange but is so tender that little else about its character can be determined. The mass can also be felt by pelvic examination but here, too, the tenderness precludes a more exact examination. He believes that exploration of the abdomen is indicated and advises hospitalization. By the time she reaches the hospital, the pain has become even more intense; in fact since the onset the pain has become progressively more severe. Her leucocyte count is 12,500 per cubic mm. There are 85 per cent polymorphonuclear forms. A flat plate of the abdomen shows no evidence of calculi or intestinal obstruction. She is examined under anesthesia just prior to operation and at this time a mass the size of a baseball is found in the right pelvis. The mass is smooth, freely movable and feels cystic; it seems to be connected with the right adnexia. The diagnosis of torsion of the pedicle of an ovarian cyst seems reasonably enough assured to make a midline incision.

It is readily seen that the directing and differentiating finding in this record is the palpable mass. This should be carefully sought for in every abdominal emergency. When the examination is at all unsatisfactory because of rigidity or tenderness, examination under anesthesia should be done. Fortunately the opportunity for this is present when the patient is being anesthetized for surgery, and this opportunity should be regularly utilized. This procedure in many cases will establish the diagnosis; while in practically all instances, it will aid the surgeon in choosing the incision which offers the greatest facility for the performance of the operation.

There are several factors which aid in the diagnosis of torsion of the pedicle of an ovarian cyst although these findings will not be present in a majority of cases. The patient may have been aware of the presence of a mass in the abdomen for some time. If she notices an increase in the size of the mass following the onset of her abdominal symptoms, this is highly suggestive of hemorrhage into the cyst following torsion. The radiation of pain down the anterior and lateral aspect of the thigh although present in only 15.9 per cent of

the cases in this series is sufficient characteristic to justify consideration of torsion of the pedicle of an ovarian cyst whenever this finding is present.

In some cases considerable valuable information can be obtained from a flat plate of the abdomen. Ordinarily, by the time a simple ovarian cyst has reached sufficient size to produce a shadow by *x*-ray, it can be easily palpated by physical examination, although it may be difficult even in cysts of moderate size to be sure that the shadow in the *x*-ray is an ovarian cyst. Dermoid cysts on the other hand can be diagnosed with reasonable certainty whenever teeth or bone are present. Glass and Rosenthal[6] found that calcareous deposits were present in 49.4 per cent of the dermoid cysts of the ovary reviewed by them while Marshall[13] found that only 18 per cent of his series of dermoid cysts had bone or calcareous material. Robins and White[19] find that a diagnosis of dermoid cyst can be made in some cases even in the absence of calcareous material. They find that dermoids by *x*-ray are characterized by a round or oval mass of decreased density, regular in contour, which has a banded mottled appearance. The mass is delineated by a thin ring of increased density. In children the diagnosis of torsion of an ovarian cyst is notoriously difficult. However, many of the cysts in the low age groups are dermoids, and the *x*-ray will be of great aid in making the diagnosis. The *x*-ray is also of value in helping to rule out some of the abdominal conditions which might easily be confused with a twisted ovarian cyst.

SUMMARY

The records of sixty-nine patients with torsion of the pedicle of an ovarian cyst have been reviewed. Certain aids in establishing the diagnosis have been discussed.

REFERENCES

1. Armstrong, J. Bilateral twisted ovarian tumors. *Brit. M. J.*, 1: 84, 1918.
2. Barron, C. Torsion of normal ovary; case of reoccurrence of rare pathological condition. *J. A. M. A.*, 102: 1675, 1934.
3. Bernstein, P. Torsion of pedicle in ovarian tumors. *Arch. Surg.*, 35: 787–794, 1937.
4. Frank, R. T. Gynecological and Obstetrical Pathology. P. 365–367. New York, 1931. D. Appleton & Co.
5. Gardiner, G. H. Ovarian Tumors. Lewis' Practice of Surgery. Vol. 11, p. 31–32. Hagerstown, Md., 1928. W. F. Prior & Co.
6. Glass, M. and Rosenthal, A. H. Study of dermoid cysts with suggestions as to use of *x*-ray in diagnosis. *Am. J. Obst. & Gynec.*, 33: 813–820, 1937.
7. Grotenfeldt, C. Über Stieldrehung der Ovarialtumoren. *Mitt. d. gynäk. Klin.*, 9: 133–301, 1911.
8. Haines, C. E. and Edgerly, W. S. Torsion of the pedicle of ovarian cysts in young children. *Med. Rec.*, 144: 121–125, 1936.
9. Helvestine, F. Torsion of the pedicle of ovarian cysts. *Am. J. Obst. & Gynec.*, 9: 259–262, 1925.
10. Jolly, R. Ueber den Mechanismus der Steiltorsion von Ovarientumoren. *Ztschr. f. Geburtsch. u. Gynäk.*, 60: 87–114, 1907.
11. Koucky, J. D. Torsion of ovarian cysts. Diagnostic value of referred pain. *S. Clin. North America*, 8: 663–668, 1928.
12. Küstner, O. Das Gesetzmäsige in der Torsionspirale Torquirter Ovariaitumorstiele. *Centralbl. f. Gynäk.*, 11: 209–214, 1911.
13. Marshall, J. M. Diagnosis of dermoid cysts of the ovary. *Proc. Staff Meet., Mayo Clin.*, 3: 4, 1928.
14. Park, W. D. Bilateral torsion of the ovary. *Brit. M. J.*, 1: 922, 1939.
15. Payr, E. Weitere Experimentalle und klinische Beitrage zur Frage der Steildrehung Intraperitonealer Organe und Geschwulste. *Deutsche Ztschr. f. Chir.*, 85: 392–451, 1906.
16. Pfannensteil. (Quoted by Frank[4] p. 365.)
17. Prichard, J. A. Bilateral twisted ovarian cysts. *Brit. M. J.*, 1: 1077, 1925.
18. Robins, C. R. Ovarian cyst with torsion of the pedicle; a case in a woman 77 years old. *J. South. Med. & Surg.*, 97: 549–551, 1935.
19. Robins, S. A. and White, G. Roentgen diagnosis of dermoids cysts of the ovary in the absence of calcification. *Am. J. Roentgenol.*, 43: 30–34, 1940.
20. Reuben, M. S. Torsion of ovarian cysts in children. *Arch. Pediat.*, 43: 54–59, 1926.
21. Sanes, K. I. Observations of torsion of ovarian cysts with report of cases. *Am. J. Obst.*, 71: 76–95, 1915.
22. Sneierson, H., Schlesinger, J. and Gold, A. E. Traumatic torsion of ovarian pedicle. Medicolegal study with presentation of cases and review of literature. *Am. J. Surg.*, 45: 546–556, 1939.
23. Steel, W. A. Torsion of ovarian cysts in children. *Brit. M. J.*, 2: 798–800, 1931.
24. Wiener, S. Complications of ovarian tumors. *Am. J. Obst.*, 72: 209–244, 1915.
25. Wong, A. I. H. Ovarian cysts with torsion of the pedicle. A report of 52 cases from the gynecological service of Johns Hopkins Hospital and 11 cases observed in China. *Chinese M. J.*, 42: 625–645, 1928.
26. Zellhoefer, H. W. K. Gangrenous ovarian cyst: twisted pedicle report of a case. *Proc. Staff Meet., Mayo Clin.*, 11: 111, 1936.

DISLOCATION OF THE TOES

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DISLOCATION of one or more toes in the metatarsophalangeal joints is a rare occurrence, just like the luxation of the fingers in the corresponding metacarpophalangeal joints. But while the displacement of the big toe, due to its exposed position, is more frequent than an injury of the four lateral toes, it is still less common than the analogous one of the thumb.

FREQUENCY AND OCCURRENCE

According to the statistics of René Sommer,[5] collected from large series of all types of luxations, dislocations of the toes were found in fifty-one cases or 0.8 per cent, the greater part of it affecting the big toe.

It is interesting to note that before the increase of industrial accidents, an overwhelming majority occurred to people connected with horses, such as riders and drivers. Malgaigne, for instance, found fourteen cases out of seventeen among horsemen. Slipping off the stirrup-plate while mounting a horse has been described in two cases. Another was caused by stepping upon the calk of a horseshoe lying on the ground. Notta saw a dislocation of the big toe when the foot was run over by the wheel of a car. A dislocation to the medial side, caused in the same manner was observed and reduced by Mouchet.[3]

A fall from a horse or with the horse is several times mentioned in the literature. Letenneur took care of an officer who had a dorsal dislocation of the big toe accompanied by a subluxation of the first metatarsal upon the first cuneiform. The only lateral dislocation of the first toe has been described by Ssolowjew (1907), brought on by a forced pronation of the foot while falling with the horse. The base of the phalanx was pushed in between the heads of the first and second metatarsus. The skin over the medially protruding head of the first metatarsal was taut and porcelain-white, later becoming gangrenous.

Since the luxation of the big toe hardly ever gives rise to any doubt as to the diagnosis, we will restrict ourselves here chiefly to the injuries of the four lateral toes. It is obvious why dislocations of the smaller toes are so rare. The basal phalanges of the toes are rather short, thus providing merely a small lever for a traumatizing force. They are also well protected by the leather sole of the shoe which prevents the necessary hypermotility, and especially hyperextension. As shown, however, by accidental or late discovery of neglected cases, we may assume that some are not recognized at all.

Failure to make the correct diagnosis on the smaller toes in spite of an *x*-ray picture may be due to two facts:

First, a dorsoplantar view alone does not always show the metatarsophalangeal joints very well, because the contours of the bones are often more or less overlapping, particularly if the toes are in a cocked-up position as in the case of existing hammertoes. A lateral or oblique view, on the other hand, might be difficult to interpret, because some of the joints are projected one over the other. However, if the possibility of a dislocation is kept in mind after a careful history and clinical examination, the inspection of the radiographs should positively eliminate any doubt.

Second, a delayed or overlooked diagnosis is due to injuries which dominate the picture, such as fractures of the limbs, the skull or the spine. If these injuries prohibit early walking, a dislocation of a toe might well pass unrecognized for it seldom causes any pain or discomfort. Moreover, unlike

luxations of fingers, the displacement is not very conspicuous of one or more toes in the basal joints, save the one of the big toe.

Fig. 1. View of second toe from medial side, showing relation of tendons to joint capsule and ligaments. Ate, aponeurosis of the extensor tendon; Mi, musculus interosseus dorsalis; Ml, musculus lumbricalis; Fl, tendon of flexor digiti longus (perforans); Fbr, tendon of flexor digiti brevis (perforatus); Vt, vincula tendinum.

Because of the variable lengths of the four lateral toes it is difficult to decide whether or not a shortening is present. The thick and dense cushions of the plantar structures tend to cover up any existing prominence of one or more metatarsals.

In the presence of these signs, the decision as to whether there is a fracture or a dislocation rests entirely upon the *x*-ray findings. Due to the same mechanism both may exist together. The absence of crepitation as a differential diagnostic aid is not very reliable.

Theoretically, the basal phalanx can be displaced in four directions: dorsal, plantar, medial or lateral. The dorsoproximal dislocation is the most common. Some cases, however, show a combination in this way that the toe is completely dislocated dorsally, partially to one side and at the same time being more or less rotated. An explanation for this may be seen in Riedinger's experiments. He found that the dorsal displacement is possible only after angulation and rotation.

Available case histories so far have not always been very clear in their description of the trauma. Most accidents are brought on by a fall or a forced jump on uneven ground, or a crushing injury to the foot,

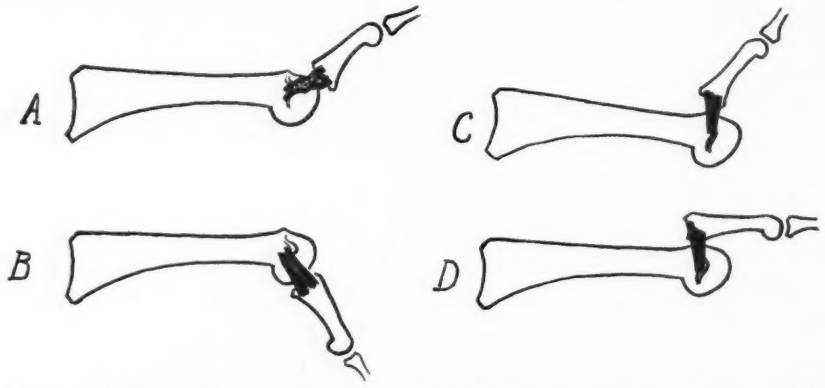


Fig. 2. Diagrammatical view of the collateral ligament under different conditions. A, ligament relaxed in slight dorsiflexon of toe; B, ligament taut in volar flexion of joint; C, ligament taut with toe in dorsal subluxation; D, ligament taut with toe completely dislocated.

A typical deformity indicative of a dislocation can be seen only within the first few hours following the accident. Examination later reveals a diffuse swelling of the foot over the dorsal aspect, including the area of the joints involved, as well as a circumscribed tenderness and limited motility. Forty-eight hours up to one week following the trauma, a subcutaneous, localized plantar hematoma might develop.

which may have had little or no protective footwear.

A dislocation of the fourth and fifth toes was seen by Chauvin[1] after a fall five meters high on rough ground, exactly like the one described in our Case 1. Another one was seen by Ullrich[6] after a leap into shallow water. Mouchet[2] found a dislocation of the fourth toe caused by bumping the extended and somewhat adducted foot.

Only one case of luxation of all toes to the lateral side has been observed by Pailloux and Josse.

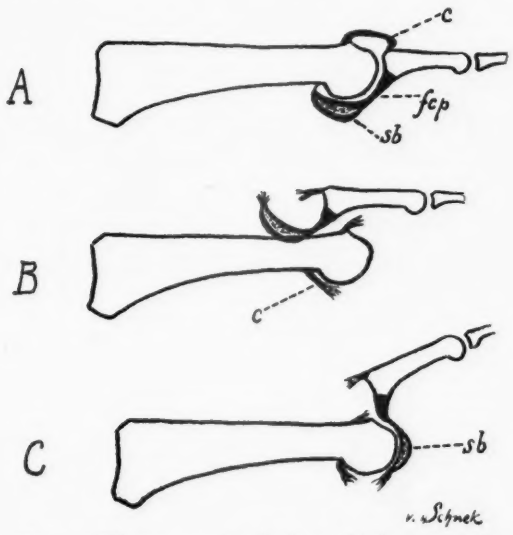


Fig. 3. Diagrammatical view of joint capsule under normal and pathological conditions. A, insertion of capsule closely to cartilage, forming a triangular lip plantar at the base of the phalanx; B, complete dorsal dislocation. The volar part of the capsule with the sesamoid bone is incarcerated. C, dorsal subluxation. Plantar part of capsule drawn hood-like over the head of the metatarsal. c, joint capsule; fcp, fibrocartilaginous plate; sb, sesamoid bone.

In some cases concerning horsemen the pressure from the stirrup seemed to be responsible. In 1915, Orth obtained a very good description from a cavalryman who fell with his horse and suffered a medial dislocation of the fifth toe. As weight-bearing was very painful, open reduction was performed with good results.

Styx reported about a chronic luxation of the second toe. Pressure against the prominent base under forced longitudinal traction would reduce it, but it reoccurred with the next active movement.

In one case, in which a man fell forward from a wagon while the tip of his boot was caught between two boards, luxation took place, forcing the toe in hyperflexion.

MECHANISM OF THE DISLOCATION

An analysis of these histories as to the mechanics and our own observations show four principal ways in which the injury is acquired:

The most common cause apparently is

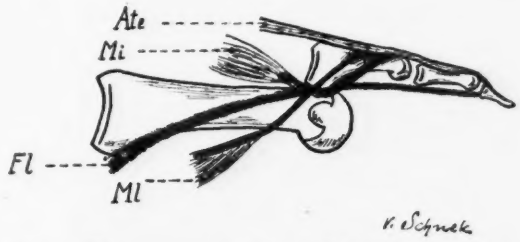


Fig. 4. Diagrammatical view of dorsal dislocation with incarceration of tendons. Ate, aponeurosis of extensor tendon; Mi, musculus interosseus; Ml, musculus lumbricalis. The tendons of these two muscles are blending with the dorsal aponeurosis. Fl, tendon of m. flexor digiti longus.

forced hyperextension. The plantar part of the joint capsule is torn from its insertion on the head of the metatarsal bone and drawn hood-like over the capitulum when the toe is dorsally dislocated. If caught between the bones it might form a serious obstacle for the reduction. The thinnest part of the capsule is on the dorsal side. Here the basal phalanx easily penetrates through a rent of the fibers. (Fig. 3.)

The dorsal dislocation might also be produced by a *parallel shearing* force. This is the case in jumping upon some small object which protrudes from the ground and forces the phalanx straight up. As soon as the two bones which constitute the joint lose contact, the reflectory contraction of the tendons causes the overriding and shortening, thus making the dislocation complete.

Finally, we find either a fall straight forward or bumping the tip of the toe against a hard object as the cause. Schultze pointed out that the toes, in the event of a fall, are always in plantarflexion. Fixed by the action of the tendons the thin dorsal part of the capsule must give way. This accounts for the frequency of a dorsal deviation. Among ballplayers it is exactly the same mechanism which causes dislocations of fingers or a rupture of the extensor tendon.

Once the diagnosis is established reduction should be attempted as soon as possible. Contrary to fractures, the chance to accomplish a closed reduction dwindles rapidly as time elapses. The muscle spasm which serves as a natural defense against pain leads within a relatively short time to a contracture of the powerful flexor muscles. Here as in other dislocations the short-fibered muscles, originating or inserting close to the afflicted joint, show a rigid spasticity and very soon a true shrinkage of their length. In our case it is the flexor digitorum brevis as well as the lumbricales and interossei.

Even at an early stage the attempt at reduction might meet with considerable difficulty. The explanation may be found in some anatomical facts.

ANATOMY

The metatarsophalangeal joints are true *free joints* like the corresponding junctions of the hand, although their range of motion is far less. This fact is almost forgotten because their development and use among civilized races are impeded by the influence of footwear. There are, however, enough cases on record in which congenital or accidetnal loss of the upper extremities forced the use of the toes to almost finger-like dexterity through constant training.

The joint surface of the head of the metatarsus represents a spherical segment, while the base of the phalanx is much smaller and forms a transverse, shallow, oval-shaped, concave socket.

The capsule is very wide and slack. Its insertion is close to the cartilage on all sides, with the exception of the plantar side where it recedes about 5 mm. The dorsal part is very delicate and in close connection with the extensor tendon aponeurosis. The plantar part is reinforced to the so-called lamina fibrocartilaginea which arises from the rim of the basal phalanx, thus forming a lip to enlarge the concave socket. It contains the sesamoid bone or bones and is a continuation of the transversal ligaments between the metatarsal heads. It also forms the upper wall of the sheath for the flexor tendons. (Fig. 3.)

Two strong collateral ligaments—one on either side like in a hinge-joint—originate from a distinct groove of the metatarsal head and extend fan-like to their insertion at the base of the phalanx. They are relaxed when the joint is straight, but due to their course and eccentric arrangement, become taut with increasing flexion. (Fig. 2.) Their plantar fibers are called ligamenta plantaria accessoria. If the dislocation is complete, the collateral ligaments clutch the wider part of the capitulum between themselves known as button-hole mechanism. Given sufficient time to shrink in this pathological position they can render reduction impossible. Another function of the collateral ligaments in the intact joint is to check the lateral movements of the toes when they are flexed. As can be better demonstrated on the fingers, abduction (spreading) is only feasible with the joints extended or slightly flexed, but is inhibited at 90 degrees flexion.

Active movements of the metatarsophalangeal joints comprise: plantarflexion, dorsiflexion (extension), adduction and abduction (spreading of the toes). Passively, a moderate degree of rotation is also possible.

The aforementioned fibrocartilaginous plate contains the sesamoid bone or bones. Two of them are regularly found under the basal joint of the big toe. One or two smaller ones are frequently seen on the fifth and less often on the fourth toe. In rare cases they may be present on all joints.* In case of a dislocation they are important in so far as they might become interposed with the rest of the capsule and increase the difficulty of reduction. (Fig. 3.)

Other structures in close vicinity of the articulation comprise the tendon of the musculus interosseus dorsalis and plantaris and the tendon of the musculus lumbricalis.

* I published a picture of supernumerary sesamoid bones on all toes bilaterally in 1932. Vide Roentgendiagnostik der Knochenverletzungen. Vienna, 1932. Wilhelm Maudrich.

Each is separated from the bone by a small bursa. Another bigger bursa (intermetatarso-phalangea) exists on the medial and lateral side of the head of the second, third and fourth metatarsus. Disregarding other muscles of minor importance like the abductor digiti quinti and the caput transversum of the abductor hallucis, there are at least an average of six to seven tendons around each joint. All the different textures are closely interwoven and connected by strands of ligaments. (Fig. 1.)

It is clear from this description that the interposition of one of the tendons is a frequent and most embarrassing complication. Similar to the buttonhole luxation of the thumb this incident may render all efforts futile. (Fig. 4.)

Thus it is apparent that this small and seemingly simple joint offers highly complicated conditions in case the normal relationship of these structures is disturbed.

Reduction, however, as a rule is easily accomplished, if the dislocated toe shows a deviation to the side or a rotation. For this is only possible, if one of the collateral ligaments is completely torn and thereby the interfering tension removed.

Either type has its advantages or disadvantages. As long as the collateral ligaments are intact, the joint shows no tendency to redislocate, because they reassume their rôle as a safeguard and lock. Reduction on the other hand is simple in case of a torn ligament, but the phalanx tends persistently to slip out of place.

TREATMENT

The *technic of reduction* follows the procedure employed in a common dislocation of the thumb, viz., hyperextension, distal pressure and finally flexion.

Difficulties may arise from the smallness of the toes which prevents a good grip and offers merely a short lever. The firmness of the surrounding structures, increased by hematoma and swelling, also impedes manipulation.

In order to provide a better grasp for the operator's fingers the skin should be daubed with some glutinous stuff, a solution of mastix, e.g., and strips of adhesive tape applied. Often rubber gloves will suffice.

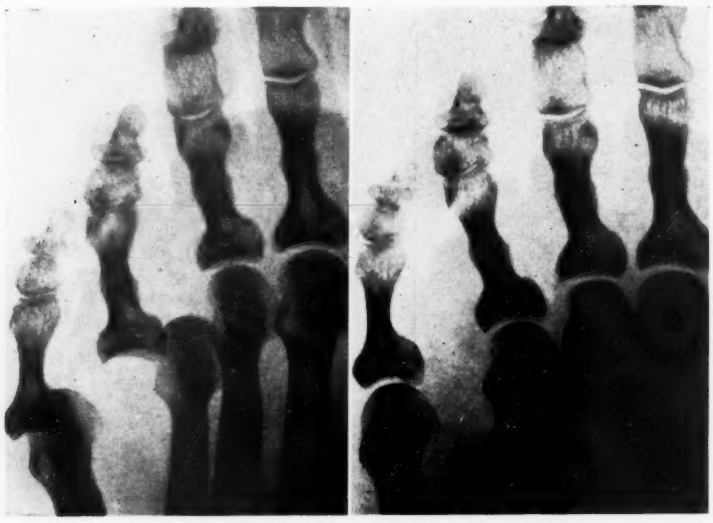
It must be emphasized that *proper anesthesia* facilitates the procedure and often means the balance between success and failure. Elimination of pain prevents the otherwise inevitable muscle spasm. Except with old, neglected cases *local anesthesia* with 2 per cent novocain is the anesthetic of choice. Fifteen to twenty-five cc. injected directly into the joint and neighborhood provide excellent conditions, because it makes the surrounding tissues more succulent and breaks up already formed adhesions.

As to the proper manipulation, simple longitudinal traction should always be tried first. Here, as in other instances, it is not so much a matter of rude force as of gentle pull for a *sufficient length of time.* The already shortened tissues must be given *time* to relax and stretch. If these rules are observed, the dislocated part often slides back into place so gently that it is hardly noticeable. Only the normal appearance and the free motion testify to the results which ought to be checked immediately by *x*-ray.

If mere traction does not prove successful, rotation might be tried in order to free some interposed tissue. At last the classical way of hyperextension and distal pressure should be attempted. If for some reason the operator fails to get a good grip with his fingers, he can replace them temporarily either by a loop of twine or by the ring of a key which provides an excellent lever.

After successful reduction the joint should be immobilized in order to allow undisturbed healing of the torn tissues. For a patient confined to bed because of other injuries, strapping with multiple layers of adhesive tape is sufficient, provided the adjoining toes are included as a splint. A small pad should be placed beneath the head of the second and third metatarsal bone to preserve the transverse arch. If, however, the patient is ambulatory from the very beginning, immobilization by

means of a carefully molded plaster of paris cast is indicated. The duration of the necessary immobilization depends especially on the age of the patient, the type of dislocation and other injuries of the bones. The average time is about three to five weeks. A prolonged time of initial fixation will be well compensated for by the absence of pain or other ill after-effects.



A B

Fig. 5. Dorsolateral dislocation of fourth and fifth toe (Case 1) before and after reduction. Note the wide space between the fourth and fifth metatarsal bone as a consequence of ther uptured intermetatarsal ligaments.

Operative intervention may become necessary in case the closed reduction fails.

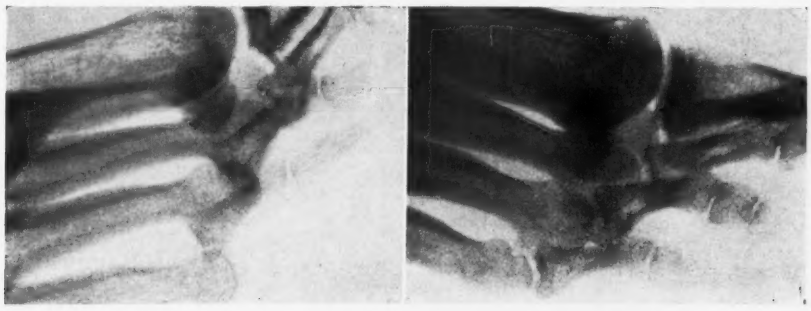
Since plantar scars should be avoided whenever possible, preference is given to a dorsal or laterodorsal incision. Although the operation might be done very well under local anesthesia, the use of a general anesthetic is sometimes advisable. It permits the application of a tourniquet, thus giving better view to identify the different structures. Besides it is occasionally helpful to apply traction to the toe by means of a stainless steel wire passed through the tip of the phalanx.

After removal of the surrounding scar tissue the ends of both bones are thoroughly freed and mobilized. Sometimes this is possible only after severance of the shortened lateral ligaments and excision of the torn joint capsule. Any incarcerated tendon should be freed and put back in its original place. In old cases the dislocation can often be reduced in the open wound by digital pressure, but it has a tendency to redislocate as soon as the pressure is released. The resection of the base of the phalanx has to be resorted to unless the corrected position can be maintained by using chromic catgut. No attempt is made to form or restore the excised capsule as it will be replaced by connective tissue. After closure of the wound a well molded dorsal and plantar plaster of paris splint is applied, exerting just enough pressure to maintain the position. The patient is kept in bed at least until the skin is well healed. Radiographs after one or two weeks are essential to make sure that the dislocation does not reoccur. Then the patient is permitted to walk with a well fitted cast.

Old, unreduced dislocations produce an increased diameter of the foot in the dorsoplantar direction due to the overriding of the bones. At first, the prominence is found over the dorsum corresponding to the displaced base of the phalanx, but as the patient walks about the pressure from the shoe forces the protruding toe down to the level of the others, pushing the head of the metatarsus underneath out of its place toward the sole. The ensueing complaints

are the same as in a case of metatarsalgia following a severely flattened transverse arch, such as constant pain, corns, bursitis

The lateral view was interesting in so far as it showed clearly the dorsal dislocation of the fifth toe. The outline of the fourth metatarso-



A B

Fig. 6. The same case as in Figure 5, lateral view before and after reduction. Due to superimposition of the bones the dislocation, especially of the fourth toe, might be easily overlooked.

or even deep pressure sores. The resection of the base of the phalanx generally brings relief.

CASE REPORTS

Case I. A fifty-five year old carpenter fell from a roof about 9 feet high on uneven, soft ground. He suffered a concussion of the brain and a fracture of the elbow, as well as lacerations about the face and multiple bruises. When first seen he was in shock and in a semiconscious condition. Due to the head injury he had a retrograde amnesia, therefore, nothing could be learned as to the mechanism of the trauma. Within the following days his general condition improved. Then the patient began to complain of pain in his left foot. Examination revealed a deformity at the base of the fourth and fifth toe. In spite of the already present swelling a probable diagnosis was made of dorsal dislocation of these two toes, which was confirmed by a subsequent *x*-ray film.

The dorsoplantar picture shows the fourth toe the full width of the base laterally displaced, while the fifth toe is only partially dislocated to the lateral side. The overlapping with the heads of their respective metatarsals can readily be seen.

The first glance revealed that the distance between the fourth and fifth metatarsal bones was unusually wide as compared to the others. It conveys the impression that the phalanx of the fourth toe had been driven like a wedge between these two bones. This, of course, was only possible if the transverse intertarsophalangeal ligaments were torn. (Fig. 5A).

phalangeal joint, however, was so difficult to distinguish from the other bones that the deviation was hardly discernible. This was an excellent example of how easily an injury might be overlooked, as I mentioned on a previous occasion. (Fig. 6A.)

At this time an attempt at reduction without anesthesia met with failure due to pain and reflectory muscle spasm. Ten days after the injury the patient had improved so much that an open reduction was considered under local anesthesia because of a chronic myocarditis.

Infiltration with 20 cc. of 2 per cent novocain solution produced perfect anesthesia and relaxation. Thus with the patient on the operating table and everything prepared for surgery, once more a closed reduction was attempted.

Using rubber gloves made it easy to get a good grip. The toes slipped back into place with a slight snapping sound as soon as sufficient pull was exerted. An *x*-ray picture confirmed the reduction. (Figs. 5B and 6B.) Since the patient was confined to bed because of his other injuries, the two joints were immobilized with a few layers of adhesive tape around the forefoot.

Recovery was uneventful. The foot was supported by adhesive strapping and walking was begun four weeks following the injury. After ten months there was complete function without any pain or discomfort.

Case II. A thirty-nine year old bricklayer, while working on a scaffold about 6 feet high, lost his balance and was forced to leap, landing on his feet. As he struck the ground which was littered with fragments of brick, he felt a sudden pain in his left foot. Afraid of loosing the job he had just secured, after a long time of

unemployment, he disregarded the injury and kept on working. The first few days after the accident walking was difficult due to considerable pain, but this condition improved steadily after one week. As the acute swelling gradually subsided he noticed a distinct shortening of the second toe and a deformity at its base. Eight weeks later he had no noticeable discomfort, but could feel a hard prominence on the sole of his foot. During the following months, however, the constant pressure over this area developed an increasing painful bursitis which finally forced him to seek medical aid.

The clinical picture was very indicative of an inveterate dorsal dislocation of the second toe. The skin of the dorsum still showed moderate edema with obliteration of the normal wrinkling and the sharp delination of the interdigital folds. The head of the second metatarsal bone was prominent and palpable from the plantar side. The toe itself was dorsiflexed and looked almost like a hammer-toe. Passive motion of the metatarsophalangeal joint was restricted to a few degrees, so that it had to be considered as a fibrous ankylosis. The *x*-ray picture revealed a complete dorsal dislocation with considerable shortening and overlapping.

Under these circumstances a closed reduction was out of question and the patient consented to an operation.

With a tourniquet applied the joint was freely exposed by a 3 inch dorsal incision. The ends of both bones and the former joint space were found covered with dense, fibrous scar tissue which had to be removed by sharp dissection. Only after severance of the collateral ligaments on both sides could the basal phalanx be moved at all. The cartilage of the joint surfaces was well preserved and shiny. The plantar part of the capsule with the fibrocartilaginous plate was pulled over the head of the metatarsus, causing a real interposition. This disc-like piece was on both sides in connection with the lateral ligaments, apparently by secondary adhesions. After excision of this part, the phalanx could finally be reduced with some difficulty and held in place by digital pressure. Upon releasing the pressure, however, the toe snapped back into the dislocated position. Therefore the proximal half of the basal phalanx was resected, thus securing good alignment and straightening out the toe immediately. At the same time the head of the metatarsus which had been displaced by the pressure of the dislocated toe, could be lifted easily to the level of the neighboring metatarsal bones, restoring the normal transverse arch of the foot.

The patient made an uneventful recovery and returned to work after five weeks with full function of the foot.

SUMMARY

1. Dislocation of one or more toes in the metatarsophalangeal joint is rare and, therefore, often not diagnosed.

2. The anatomy of the joint structures and their relationship to the mechanism of the dislocation is reviewed.

3. The method of closed reduction in simple cases is described. Operative procedures for nonresponding cases and old dislocations are discussed and an example for each is given.

REFERENCES

1. Chauvin, E. Luxation der Zehen. *Centralbl. f. Chir.* nr. 38, 1920.
2. Mouchet et Bruat. Luxation metatarso-phalangienne isolée du 4. orteil. *Centralbl. f. Chir.*, p. 1704, 1924.
3. Mouchet, A. et Guillermin. Luxation interne du gros orteil. *Centralbl. f. Chir.*, p. 1706, 1924.
4. Orth, Oskar. Traumatische Luxation der 1. Phalanx der rechten Kleinzehe im Metatarsophalangealgelenk. *Centralbl. f. Chir.*, nr. 42, 1915.
5. Sommer, René. Die traumatischen Verrenkungen der Gelenke. Stuttgart, 1928. Ferdinand Enke.
6. Ullrich, J. Et tilfaelde af luxatio metatarsophalangea i 3de og 4de taa. *Hospitalstidende*, nr. 37, 1906.

UNUNITED FRACTURES OF THE CARPAL SCAPHOID*

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CONSIDERABLE differences of opinion exist in regard to the therapy of ununited fractures of the carpal scaphoid. In principle, the treatment has varied from the most conservative type of prolonged immobilization to the most radical excision of the whole proximal row of carpal bones. Prolonged immobilization, excision of one or both fragments, excision of the whole proximal row of carpal bones, fusion of the fragments by means of bone graft[1] and even fusion of the wrist[4] have all been recommended and each has been attended with varying success.

In recent literature[3] the tendency has been to discard the mutilating excision operations and rely more on fusion between the fractured fragments. It may be doubted whether the satisfactory outcome in this latter method is due to the bone graft or to the drilling which is a necessary prelude to the insertion of the bone graft. If, as Bohler believes, simple drilling is sufficient, considerable operative manipulation could be avoided. In this light the following two cases may prove interesting:

CASE REPORTS

CASE I. S. B., a white male, nineteen years old, fell on his left hand February, 1939. *X*-rays taken at that time were reported negative for fracture. He was again seen in December, 1939, ten months after the injury, because of a dull ache in his left wrist. *X*-rays at this time revealed cystic changes along the line of fracture. His left wrist was immobilized in a circular plaster of paris cast for about nine weeks. Repeated roentgen studies failed to reveal any bony union of the fragments. Upon removal of the cast February, 1940, he complained of weakness of the wrist and tenderness in the "snuffbox." Examination revealed a slight atrophy of the left lower forearm and hand and considerable limitation of dorsal and volar flexion of this wrist. The right forearm and wrist were normal. *X*-rays (Fig. 1) at this time showed a fracture of the left scaphoid with no appreciable separation of the fragments. On February 27, 1940, under tourniquet above the elbow, an incision was made in the anatomical snuffbox. The extensor pollicis longus was retracted medially and the scaphoid bone was exposed. Several drill holes were made from the tuberosity proximally. After wound closure, immobilization was affected by a circular plaster of paris cast with the wrist in marked extension and radial deviation.

The postoperative course was uneventful and the patient left the hospital March 2, 1940. The cast was not removed until April 26 (eight and one-half weeks postoperatively) when the *x*-ray examination (Fig. 2) showed bony union. Stereoscopic examination May 7, 1940, showed union. Check-up examination on November 19, 1940, showed that the patient had a good grip, he could flex and extend this wrist almost as well as the other wrist. He was able to resume his usual work. He could lift things with this hand if they were not too heavy (he lifted a chair without experiencing any pain at the wrist). *X*-rays showed bony union.

CASE II. S. S., a white male, seventeen years old, fell on his left hand about the middle of January, 1940. *X*-ray showed a fracture of the scaphoid. He was properly immobilized in a circular cast for six and a half weeks. Upon removal of the cast there was pain and weakness of grip and limitation of flexion and extension of the left wrist. *X*-rays (Fig. 3) showed that the fracture was still present. The same operative procedure as in Case I was performed April 4, 1940, and a cast similarly applied. The patient was discharged from the hospital April 9, 1940, and the cast was removed about ten weeks postoperatively. *X*-rays (Fig. 4) showed good bony union. Check-up examination on

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FIG. 1. Case I. Shows fracture of left scaphoid.

FIG. 2. Case I. Shows bony union.

FIG. 3. Case II. Shows fracture of left scaphoid.

FIG. 4. Case II. Shows bony union.

FIG. 5. Case III. Shows fracture of right scaphoid.

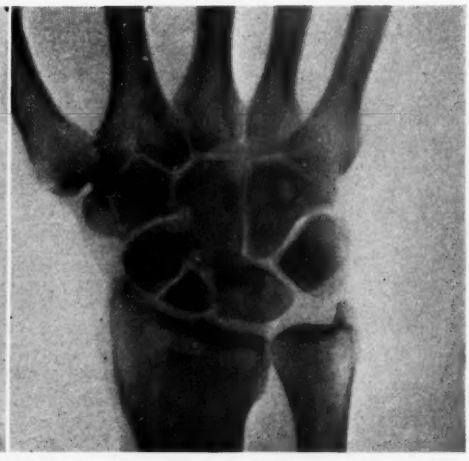

FIG. 6. Case III. Shows ununited fracture of scaphoid.

October, 30, 1940, revealed that this patient had no pain in the left wrist, although before the operation pain was present even when resting this hand. Flexion and extension were a few degrees less than the opposite side. The grip was good now whereas before the operation it was weak. He casually mentioned that he played handball a few days after the removal of the cast and shortly thereafter he rode a bicycle and played association football.

Although these two cases demonstrate that satisfactory union may be secured by simple drilling, it is not intended to indicate that drilling, or any other surgical procedure is absolutely indicated once the diagnosis of nonunion has been made. In all instances the clinical picture must be considered paramount. In an earlier article[5] attention was called to the fact that in acute fractures of the navicular, greater reliance was to be placed upon the clinical picture than upon the negative result of a roentgenogram. Similarly, the indications for therapy must depend more on the patient's disability than upon the simple roentgen demonstration of the absence of union. In fact some cases of established non-union of the carpal scaphoid require no treatment whatsoever, as the following case demonstrates:

Case III. S. H., a white male, thirty-five years old, was struck on the right wrist by some lumber November 15, 1933. When seen three weeks later, the examination and the *x*-rays (Fig. 5) pointed to the diagnosis of a fracture of the right carpal scaphoid. Immobilization by means of a circular cast was maintained for six weeks. He returned to work about four months after the injury. A year later, in December, 1934, he was exhibited at an orthopedic meeting. *X*-rays (Fig. 6) at that time showed no union and some osteo-arthritic changes of the lower end of the radius. However, the patient was able to paint walls with his right hand which requires considerable wrist motion. After the patient left the meeting, several surgeons criticized the treatment and prognosticated that this wrist would become more painful and that the function would be further impaired. They advised removal of one or both fragments. They based their remarks on the fact that the second set of films showed more pathological changes than the first.

This patient returned to my office recently for another condition, about seven years after the injury, which is six years after the meeting at which he had been presented. He stated: "I do heavy lifting, have no pain, no funny feeling, and no difficulty in using this wrist. It has never troubled me since you discharged me about six and a half years ago." Examination showed a strong grip; flexion of the wrists were equal; extension was a few degrees less on the right side as compared to the left. *X*-rays taken September 7, 1940, showed no evidence of bony union (*x*-rays of the opposite wrist were negative for fracture of the scaphoid).

CONCLUSION

1. The prognosis as to function and the question of further treatment for ununited fractures of the carpal scaphoid must be based on clinical findings rather than on roentgen films.

2. If pain and weakness of grip persist for months or longer after injury, firm bony union may be expected from the simple method of drilling.

REFERENCES

1. Adams, John D. and Leonard, Ralph D. Fracture of the carpal scaphoid. *New England J. Med.*, 198: 401–404, 1928.
2. Campbell, W. C. Operative Orthopedics. St. Louis, 1939. C. V. Mosby Co.
3. Key, J. A. and Conwell, H. E. The Management of Fractures, Dislocations, and Sprains. St. Louis, 1937. C. V. Mosby Co.
4. Thornton, Lawson. Old dislocations of os magnum. *South. M. J.*, 17: 430, 1924.
5. Rothberg, A. S. Fractures of the carpal navicular. *J. Bone & Joint Surg.*, 21: 1020–1022, 1939.

MECKEL'S DIVERTICULUM*

WITH A REPORT OF TWELVE CASES

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MECKEL'S diverticulum is not a rare congenital abnormality, however, the complications of this lesion are of such gravity that the subject is always of importance in any consideration of acute abdominal emergencies. The cases to be reported here illustrate well some of the more serious complications of this anomaly and it is believed that only by keeping such facts constantly in mind may we hope to reduce the mortality of such lesions.

The first extensive study of this anomaly was made by John Frederick Meckel in 1812.[15] The condition, however, had been mentioned in the literature in 1672 by J. H. Lavater[13] and in 1701 a good illustration of the diverticulum was given by Ruysch.

The earlier literature called attention to intestinal obstruction secondary to the anomaly. Later, peritonitis resulting from diverticulitis was reported and it has been comparatively recently, since 1925,[18] that ulceration and hemorrhage resulting from heterotopic gastric tissue in a diverticulum has been adequately studied.

Meckel's diverticulum is generally believed to occur in about 2 per cent of all individuals.[9] Most writers believe that it is usually four times as frequently observed in males as females.[12] Complications arising from the presence of the anomaly have been variously stated as occurring in 15 to 25 per cent of all cases when the diverticulum is present.[3]

The anomaly most often manifests itself as a blind pouch extending from the antimesenteric border of the ilium located from 12 to 36 inches above the iliocecal valve. In the infant it is usually about 12 inches from the cecum while in an adult the distance is usually greater.[4]

The other relationships of the diverticulum may likewise vary. It is usually on the antimesenteric border, but may be present at other locations and in some instances emerges from the mesenteric side of the ilium. Likewise, while it usually has no mesentery, it may be supplied in its entirety by such a structure. The diverticulum is normally composed of the same three layers which make up the ilium, but at times contains heterotopic tissue simulating the mucosa of the stomach, duodenum, colon or pancreas.[5,11,19]

An understanding of the embryology of Meckel's diverticulum is essential for a proper appreciation of the most frequently observed complications. There is a wide communication between the embryo and the yolk sac early in fetal life. By the fourth week of fetal life this communication has narrowed down to a tubular structure known as the omphalomesenteric duct. In normal development the duct becomes a fibrous cord between the umbilicus and the bowel, then breaks, after which both ends are absorbed.

Should development fail to follow the normal pattern, any one of several abnormal conditions may result. As a rule, these abnormalities fall into one of the three forms: (1) The connection between the umbilicus and the intestine may persist in the form of a fibrous band or as an intestinal fistula. (2) The umbilical portion of the duct may persist. (3) The intestinal portion of the duct may persist.[7]

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COMPLICATIONS

Meckel's diverticulum attracts the attention of the surgeon as a rule only when one of the several complications of this anomaly develop. These include: (1) intestinal obstruction, (2) diverticulitis, with or without perforation, (3) ulceration from heterotopic gastric tissue and hemorrhage from heterotopic gastric tissue, (4) intussusception, (5) foreign body, and (6) neoplasm.

The first three complications listed are responsible for by far the greatest number of abdominal emergencies associated with Meckel's diverticulum.

The earlier literature stressed the likelihood of intestinal obstruction resulting from a band, a volvulus or even intussusception producing obstruction. A band adhesion may extend from the diverticulum to the umbilicus or it may be attached to another loop of bowel or to the mesentery. Volvulus may occur resulting in obstruction. Reginald Fitz[8] summarized the American literature in 1884 and reported thirteen cases. He was impressed with frequency of obstruction as a complication and considered the question of diverticulitis as well, though it was absent in his cases. It is interesting that inflammation in a Meckel's diverticulum was appreciated and apparently given more attention before 1886 than was inflammation of the appendix, a far more common lesion.

Wolfson and Clurmann[21] recently attempted to differentiate between acute diverticulitis due to Meckel's diverticulum and acute appendicitis, reporting that in the former the pain is apt to be more severe and characterized by colic, the vomiting more pronounced and distention present in a higher percentage of the cases. Since acute appendicitis, a far more common lesion, may present such widely varied pictures, the author agrees with most writers on the subject in believing that the preoperative diagnosis of Meckel's diverticulitis is always very uncertain in cases in which appendectomy has not been previously performed. When perforation occurs secondary to diverticulitis or from a perforated peptic ulcer, peritonitis either general or local must, of course, result. Due to its location an acute perforation of a Meckel's diverticulum would seem less likely to become walled off than would a perforated appendix.

Probably in a number of the earlier reported cases of perforated Meckel's diverticulas due to diverticulitis the true cause was an unrecognized perforated peptic ulcer. In 1904, Salzer[17] described gastric mucosa in a Meckel's diverticulum which had prolapsed through the umbilicus. It remained, however, for Schaetz, in 1925, to focus attention on the similarity between peptic ulcers of the stomach and duodenum and those occurring in Meckel's diverticula.[18] He found gastric mucosa in five of thirty cases of perforations of diverticula. Likewise he called attention to the frequent hemorrhages per rectum in such cases. Since this the question has received far more attention.

Brennemann[2] has pointed out that the blood per rectum originating in a Meckel's diverticulum usually contains clots while that from an intussusception or from iliocolitis usually does not. Abt and Struss[1] emphasized the importance of a Meckel's diverticulum containing heterotopic tissue as a cause of rectal bleeding in children after other more common causes have been eliminated. They successfully operated on three such patients before perforation occurred.

Dragstedt[6] emphasized the importance of hydrochloric acid in the production of the peptic ulcers of Meckel's diverticula. The experimental work of Matthews and Dragstedt[14] on ulcer showing that the small bowel becomes progressively more sensitive to gastric juice as the distance from the stomach increases agrees with the clinical finding that such ulcers are quite likely to perforate.

Schullenger and Stout[19] pointed out that gastric mucosa may be present in a diverticulum and may be responsible for

bleeding or ulceration and yet be recognizable only on careful microscopic study.

Aberrant pancreatic tissue in a Meckel's diverticulum was recognized in 1861 by Zenker[22] though it occurs far less frequently than does aberrant gastric tissue. Hunt and Bonesteel[11] carefully reviewed the subject studying thirteen cases from the literature and adding one of their own.

Mucosa simulating that normally found in duodenum and colon have likewise been reported. Numerous explanations have been offered for the presence of such misplaced tissue. None of the theories advanced seem entirely satisfactory.

Meckel's diverticulum has been known to be one of the causes of intussusception since 1846. Harkins has studied the subject extensively reviewing 160 cases from the literature and reporting two of his own. He emphasizes the importance of early diagnosis and immediate operative treatment of the condition.[10]

COMMENT

The patients whose cases are reported in Table 1 were operated upon at the John Gaston Hospital by various members of the surgical staff of the University of Tennessee between 1924 and 1941. Some of the patients were operated upon by the resident surgeon and others by members of the attending staff.

The greater incidence of the condition in males in this series agrees with the findings generally recorded by other writers with

TABLE I

SUMMARY OF CASES REPORTED OF MECKEL'S DIVERTICULAS

No.	Sex	Age	Race	Admission Complaint and Findings	Preoperative Diagnosis	Postoperative Diagnosis	Operative Procedure and Result
1	M	8	C	Epigastric pain, nausea, vomiting, distention, tenderness in epigastrium. Symptoms for 48 hrs. T. 100.4°F., w.b.c. 8,600	Obstruction with peritonitis	Obstruction band, from diverticulum to umbilicus	Band divided, diverticulum excised; recovery
2	M	35	C	Peri-umbilical pain, vomiting, diarrhea. Tenderness R. L. Q. 24 hrs. duration. T. 100°F., w.b.c. 11,400	Acute appendicitis	Acute Meckel's diverticulitis	Diverticulum excised; appendectomy; recovery
3	F	8	C	Umbilical pain, constipation, vomiting, 4 days duration. T. 100.4°F. w.b.c. 10,000	Intestinal obstruction	Complete obstruction by band from Meckel's diverticulum	Band excised; diverticulum excised; ileostomy; death
4	F	19	W	Lower abdominal pain, nausea and vomiting. Tenderness in R. L. Q. 24 hrs. duration. T. 96°F., w.b.c. 27,600	Acute appendicitis or torsion of ovarian cyst	Intussusception of Meckel's diverticulum	Intussusception reduced; diverticulum excised and appendectomy; recovery
5	M	45	C	R. L. Q. pain, nausea, vomiting, tenderness, and rigidity 24 hr. duration. T. 98.2°F., w.b.c. 7,500	Appendicitis	Chronic appendicitis. Meckel's diverticulum not inflamed	Appendectomy; 1 month later diverticulum removed; recovery
6	M	5	W	Peri umbilical pain, vomiting. 5 days duration. T. 98.2°F., w.b.c. 10,050	Intestinal obstruction	Obstruction by band to umbilicus from acute Meckel's diverticulitis	Band excised; diverticulum, acute, excised; recovery
7	M	35	W	R. L. Q. pain, tenderness. 24 hr. duration. T. 99.6°F., w.b.c. 14,000	Acute appendicitis	Acute Meckel's diverticulitis	Diverticulum excised; appendectomy; recovery
8	M	17	W	Cramping abdominal pain, vomiting, slight distention. 36 hr. duration. T. 99°F., w.b.c. 6,800	Intestinal obstruction	Obstruction by adhesive bands above diverticulum	Bands resected; diverticulum excised
9	M	9	W	Peri-umbilical pain, nausea, vomiting, tenderness, and rigidity in R. L. Q. 5 hrs. duration. T. 102°F., w.b.c. 10,450	Acute appendicitis	Acute appendicitis and acute diverticulitis	Appendectomy; diverticulum excised; recovery
10	F	14	W	R. L. Q. pain, duration 4 hrs. w.b.c. 8,500. T. 99.2°F.	Acute appendicitis	Diverticulitis, normal appendix	Appendectomy, diverticulum excised; entero-enterostomy; recovery
11	M	61		Epigastric pain localizing about umbilicus, vomiting, duration 6 hrs. Tenderness, slight rigidity. T. 98°F., w.b.c. 9,950	Acute appendicitis	Acute diverticulitis	Excision of diverticulum; appendectomy; recovery
12	M	16		Epigastric pain 12 hrs. duration. Tender mass in R. U. Q., T. 98°F., w.b.c. 12,200	Intestinal obstruction	Intestinal obstruction from band, gangrenous diverticulitis	Resection of band; excision of diverticulum; appendectomy; recovery

reference to sex. Half of the cases were found in adults. Much attention has been called to the complications of Meckel's diverticulum in childhood; and while such studies are entirely appropriate, it must be borne in mind that these complications must also be considered in adults.

Intestinal obstruction was present in four cases, acute diverticulitis in four, both obstruction and diverticulitis in one, intussusception in one, and in two cases the diverticulum was only subacutely or not at all inflamed. Death occurred in only one case, this being a patient who had suffered from intestinal obstruction for four days prior to admission.

In spite of the very satisfactory outcome of eleven out of twelve cases, in no instance was Meckel's diverticulum diagnosed preoperatively. The important fact obviously is that an acute condition of the abdomen was promptly diagnosed and laparotomy carried out.

No heterotopic tissue was found on examination of these specimens. However, without making several sections from each case such tissue might readily be be missed as is seen from the work of Stout.

Granted that the most important factor in the proper management of this group of patients is early recognition of an acute condition of the abdomen followed by laparotomy, the judgment shown by the surgeon at operation is also definitely significant in determining the final result. The operative procedure used must of necessity vary with the findings in the individual case.

When intestinal obstruction is found, this must be relieved by appropriate surgical measures. If the patient is operated upon relatively early and a band is found, the diverticulum may be resected at the same time that the band is divided. If the bowel has been distended to a marked degree and the patient is acutely ill, it is far better judgment to do only enough to abolish the obstruction since leakage is more apt to occur in the bowel which has recently been damaged by severe distention. The longer operation also increases the hazard to the seriously ill patient.

Frequently, the diverticulum is resected and the defect closed by two rows of sutures or by a purse string. The broad base usually present in such cases requires care that the lumen after resection and closure will not cause obstruction. Since aberrant gastric mucosa may be present at the base as well as in the more distal portions of the diverticulum and since such tissue may not be apparent from gross examination, it is important to resect the entire diverticulum otherwise one might leave enough gastric mucosa to produce bleeding or perforation at a later date.

The method of inverting the diverticulum occasionally advised in the literature seems unwise since it not only does not remove potential aberrant tissue but also might be the means of causing obstruction or intussusception.

SUMMARY AND CONCLUSIONS

1. The common complications of Meckel's diverticulum resulting in acute abdominal emergencies are reviewed.

2. Twelve cases with one death are reported and subjected to analysis.

3. Early diagnosis of an acute condition of the abdomen followed by appropriate surgery offers the best opportunity for recovery in these patients.

4. A careful search should always be made for a Meckel's diverticulum in cases in which the operative findings do not explain the preoperative symptoms or the peritonitis encountered at laparotomy.

REFERENCES

1. Abt, I. A. and Straus, A. A. Meckel's diverticulum as the cause of intestinal hemorrhage. *J. A. M. A.*, 87: 901, 1926.
2. Brenneman, J. Some acute abdominal conditions in childhood. *Mississippi Doctor*, 15: 43, 1938.
3. Christie, A. Meckel's diverticulum: a pathologic study of sixty-three cases. *Am. J. Dis. Child.*, 42: 544, 1931.
4. Clark, D. F. Hemorrhagic Meckel's diverticulum. *Am. J. Surg.*, 22: 308, 1933.
5. Curd, H. H. A Histologic study of Meckel's diverticulum. *Arch. Surg.*, 32: 506–523, 1936.
6. Dragstedt, L. R. Ulcus acidum of Meckel's diverticulum. *J. A. M. A.*, 101: 20, 1933.

7. Everhart, M. W. The complications of Meckel's diverticulum in infancy and childhood. *J. Pediat.*, 17: 483, 1940.
8. Fitz, R. H. Persistent omphalomesenteric remains; their importance in the causation of intestinal duplication, cyst formation and obstruction. *Am. J. Med. Sc.*, 88: 30–57, 1884.
9. Gray, H. The Anatomy of the Human Body. 21st ed., p. 1182. Philadelphia, 1924. Lea & Febiger.
10. Harkins, H. N. Intussusception due to invaginated Meckel's diverticulum. *Ann. Surg.*, 98: 1070–1095, 1933.
11. Hudson, H. W. and Koplik, L. H. Meckel's diverticulum in children: clinical and pathologic study with a report of thirty-two cases. *New England J. Med.*, 206: 827, 1932.
12. Hunt, V. C. and Bonesteel, H. T. S. Meckel's diverticulum containing aberrant pancreas. *Arch. Surg.*, 28: 425, 1934.
13. Lavater, J. H. De *εντεροπεριότολή*: seu intestinorum compressione. Basilae, 1672.
14. Matthews, W. D. and Dragstedt, L. R. Etiology of gastric and duodenal ulcer; experimental studies. *Surg., Gynec. & Obst.*, 55: 265–286, 1932.
15. Meckel, J. F. Handbuch der Pathologischen Anatomie. 1. bd; s. 553–597. Leipzig, 1812.
16. Ruysch, F. Thesaurus Anatomicus. Vol. 7. Amsterdam, 1701. J. Wolters.
17. Salzer. *Wien. klin. Wchnschr.*, 17: 614, 1904.
18. Schaetz, G. *Beitr. path. anat. u. z. allg. Path.*, 74: 115, 1925.
19. Schullinger, R. N. and Stout, A. P. Meckel's diverticulum. *Arch. Surg.*, 28: 440, 1934.
20. Stern, F. K. *Deutsche Ztschr. f. Chir.*, 140: 343, 1917.
21. Wolfson, W. L. and Clurman, M. J. Inflammation of Meckel's diverticulum. *Ann. Surg.*, 92: 388, 1930.
22. Zenker F. A. *Virchows Arch. f. path. Anat.*, 21: 369, 1861.

The effect of morphine on the intestine seems to vary with conditions, but according to Paine, et al., the drug uniformly enhances both the tone and the peristaltic activity of the intestine, both normal and obstructed. From—"Surgical Physiology"—by Joseph Nash (Charles C. Thomas).

FIBERGLAS SUTURE MATERIAL

PRELIMINARY REPORT

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FIBERGLAS suture material[1] has all the requisites laid down by investigators from the time of Kocher[2] and Halsted[3] to those of the present day. As its name implies, the suture material is made of glass filaments, drawn to such fineness that 204 filaments must be combined to make a strand measuring 45,000 yards per pound. Its extreme tensile strength makes possible the use of a very fine, yet strong suture. To the sense of touch and in appearance it is like the finest silk and can be handled like silk, holding its knot perfectly. Experience has taught, and Ballas[4] has stated in his recent publication, "that glass is among the least reacting substances in tissue." Because Fiberglas is inert and nonreacting in the tissue, and practically nonsoluble, it does not cause exudation, edema, or cell proliferation; and it in no wise interferes with wound healing. Healing of wounds takes place without any puffiness and little or no swelling.

Fiberglas does not elongate, neither does it shrink; but when braided, the braiding affords a little give. It is not affected by tissue fluids, enzimotic action, or action of chemicals; neither does it produce toxins, or allergic reaction. The fact that each fiber is an extremely fine, solid filament of pure glass, makes it nonabsorbent, and in view of its being a nonirritant, it does not call forth tissue fluids which would harbor germ life, nor do bacteria attack it. The fact that it is nonsoluble precludes the formation of harmful biproducts. Glass is not classed as a carcinogenic substance.

During the past two years we have been using Fiberglas suture material experimentally both in human beings and in animals. In quite a few clinical instances we have left buried sutures which remain to date with no untoward effect. Dogs, too, have retained buried sutures without any local reaction. (Our use to date of Fiberglas suture in the human has been confined to surgery of the head and neck.)

In contradistinction to some of the more recent suture materials put on the market, we wish to emphasize that Fiberglas is not an organic plastic but real glass and thus inert. Its composition is known to the manufacturer as type "E." The tensile strength of a "12 braider tube" Fiberglas suture (approximately the size of No. 00 silk, which breaks at 7.4 pounds) is approximately 9.44 pounds; knot strength is approximately 4.41 pounds, loop strength approximately 8.1 pounds, showing Fiberglas to be much stronger than silk. It is sterilizable by all methods: autoclaving, boiling, dry heat (well below softening or melting point of glass); by chemicals (except hydrofluoric acid); and it bears repeated sterilization perfectly.

In our experiments on dogs, ten sutures of "12 braider tube" Fiberglas yarn were placed in the skin at three-day intervals. Then a strip of skin an inch wide containing the ten sutures was removed for study. The resulting wound was again closed by sutures, half of which were removed with the tissue surrounding them after three months. The others were allowed to remain for the future. It was to be expected that difficulty would be encountered in sectioning the tissue containing the Fiberglas yarn, because of the frangibility of glass. Many specimens were prepared and mounted in paraffin. Hundreds of sections were made in the

hope that in spite of that obstacle we would be able to show Fiberglas suture in a section of tissue. But invariably as the microtome blade cut through the suture, the tiny glass disks scattered throughout the field; or where the glass offered more resistance to the blade, tore their way through the tissue. A thorough study of the tissue so damaged in sectioning failed to show signs of irritative or inflammatory changes, as is shown in Figure 1. Figure 2* shows the section of a knot of Fiberglas outside of the skin, mounted in paraffin. These sutures had been *in situ* for twenty-two days. Apparently the paraffin affords more support to the suture while it is being cut than does the tissue, even though the latter is impregnated with paraffin.

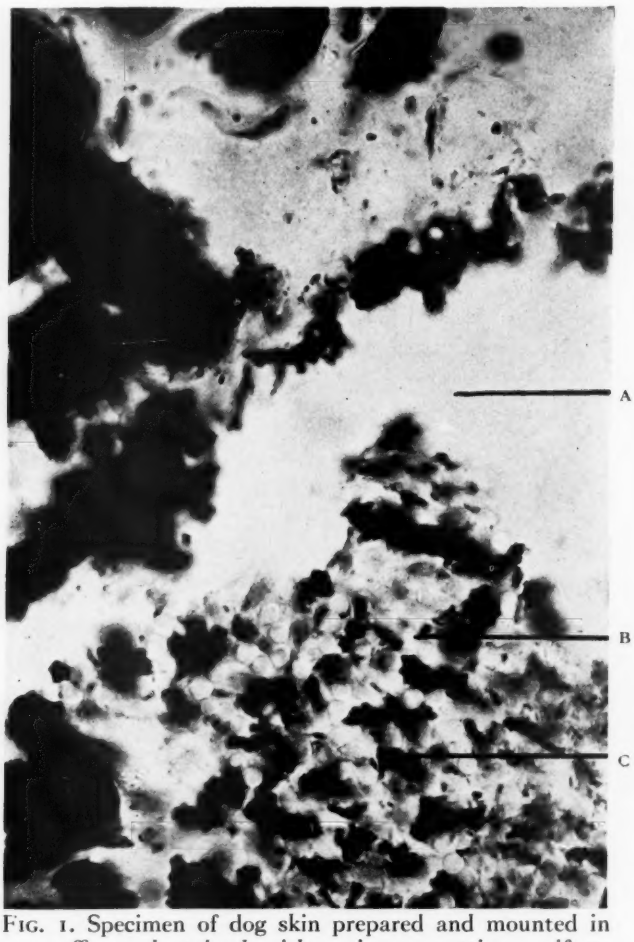

FIG. 1. Specimen of dog skin prepared and mounted in paraffin and stained with eosin. A, cutting artifact; B, fiberglas suture in cross section; C, the black particles intermingled with the glass fibers in the picture are eosin-stained animal particles and not cellular infiltration.

Fiberglas suture material has been so satisfactory in our hands in the past several years that we believe it is worthy of extensive trial and intensive study by others. It is regrettable that we were not able to show the suture in place in the tissue; possibly someone else will be more successful. In a subsequent report we hope to show Fiberglas suture which has been in

* Gradwohl Laboratories (Pasteur Institution), St. Louis, Missouri. January 30, 1942.

"All these specimens show the presence of the suture, but they were broken up by the cutting edge of the microtome, and the tissue showed no irritation from the presence of such suture material." R. B. H. Gradwohl, Director.

the tissue for a longer period, and to demonstrate the effect it has on tissue when imbedded in it for a long time.

Fig. 2. Section of knot of Fiberglas suture tied outside of dog skin prepared and imbedded in paraffin and stained with eosin. A, suture in longitudinal cut; B, suture in cross cut.

REFERENCES

1. Fiberglas. Suture material was very kindly furnished by Owens-Corning Fiberglas Corporation, Toledo, Ohio. Fiberglas is the trade name (Reg. U. S. Pat. Off.) of glass manufactured by the Corporation in any fiber or filament form.

2. Kocher, T. Zubereitung von antiseptischen Katgut. *Centralbl. f. Chir.*, 8: 353, 1881; Eine einfache Methode zur Erzeilung sicherer Asepsis Cor. *Bl. f. Schweiz. Aerzte*, 18: 3, 1888.

3. Halsted, W. S. The employment of fine silk in preference of catgut, and the advantages of transfixing tissues and vessels in controlling hemorrhage. *J. A. M. A.*, 60: 1119, 1913.

4. Bellas, J. E. Suture studies, a new suture. *Arch. Surg.*, 41: 1414–1425, 1940.

THE VALUE OF CYSTOSCOPIC PHOTOGRAPHY IN MEDICINE*

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THE value of cystoscopic photography in the practice of medicine, from the standpoint of the urologist, the surgeon or the internist, is incalculable. It is only in recent time that it has been possible to apply photography and photographic equipment in conjunction with the use of the cystoscope. Since the dawn of civilization, man has consistently attempted to examine, explore and perfectly describe the detailed anatomy and pathological lesions in the various body cavities and normal body sinuses. Urological equipment has done much toward this advancement.

Commercially, there are several instruments advanced, both in America and abroad which, unfortunately, could not be satisfactorily operated by the author. It was only after many years of research and experimentation with cystoscopic photography that the author, working in conjunction with optical engineers and expert machinists, was able to produce an instrument capable of photographically recording the normal anatomy and pathological lesions of the bladder, as visualized through the cystoscope. It is for this reason that such an extensive and elaborate study of optics, as applied to cystoscopy, was undertaken. The camera used and herein described is original.

The lens system of the camera is a complete unit in itself and is used for one purpose only, photography. It cannot be used routinely, by itself, for any cystoscopic examination or procedure, but in conjunction with the camera, presents a perfect photographic image. It is so designed as to accurately lock into a position in a standard Brown-Buerger cystoscope, No. 24 F.

The camera is of reflex type in that, by a series of lenses and mirrors, the latter made of stainless steel alloy and highly polished, the entire vesical cavity may be examined or photographed. Being of a reflex type, the main mirror of the camera also acts as a shutter, so that the portion to be photographed may be observed up to the time of the photographic exposure. At the moment of making the photographic exposure, the mirror is thrown out of position, allowing the light rays to continue in a straight line to expose the photographic negative. After exposure of the photographic negative, the mirror again falls back automatically into its original position, so that continued observation or photography may be accomplished without manipulation of the instrument.

The lighting equipment is that of the standard Brown-Buerger cystoscopic sheath. The light is stepped up by a delicate rheostat to a point of maximum intensity at the moment of making the photographic exposure.

The film used for routine work, producing a black and white photograph, is a standard Super-Ortho Chromatic Press, having a Weston light rating of 32, (Tungston). An individual cut film is used for each exposure. By using an individual cut film, it is possible to develop the films individually of any given instance in which photographs are taken, whereas with the use of roll film, it would necessitate a complete exposure of the film before developing. By the use of the individual cut film it is often possible to re-photograph a given lesion before any alteration of the pathological appearance, particularly once treatment has begun. The time of an exposure

* Presented before the Philadelphia Urological Society, November 25, 1940.

of a black and white negative varies materially with the reflective qualities of the mucous membrane of the bladder. A clear, glistening, normal appearing mucosa will reflect the light with a greater intensity and greater speed, thereby shortening the time of exposure, in contrast to a bladder mucosa that is highly inflamed in the presence of an acute cystitis. There is no set rule followed in making the exposures; one's own judgment and experience is used rather than a mechanical estimation of an exposure.

Our use of Kodachrome has been quite unsatisfactory. The photographic image produced is one of definite sharpness, but the rendition of color value is one that is far from perfect. The Kodachrome photographs produced exhibit an excess of yellow. This is attributed to the fact that the bladder mucosa, under normal conditions, is quite yellow and the usual cystoscopic light has a considerable yellow quality. Due to these facts, the results have shown a predominance of the yellow factors of the spectrum, which is decidedly not an accurate rendition of color tones and values. Further experiments are being conducted in the hope that true color values may be attained.

The value of a photographic record of any given lesion, particularly carcinoma of the bladder, is inestimable. It has been the practice of all urologists to describe the

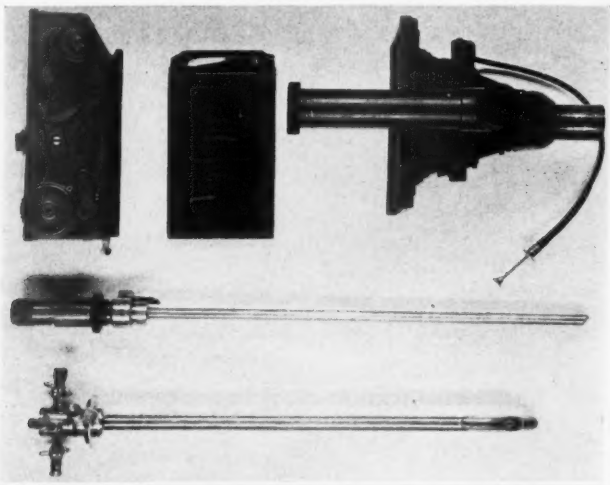

Fig. 1.

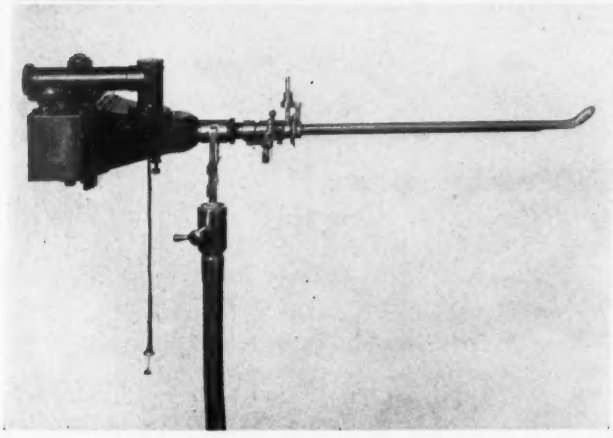

Fig. 2.

Fig. 1. The component parts of the photographic equipment. A standard Brown-Buerger No. 24 cystoscopic sheath is utilized, which holds an especially devised photographic lens. The camera (upper right) is of a reflex type and uses both an individual cut film for a black and white photograph, or an adapter for Kodachrome.

Fig. 2. Complete assembly of the photographic equipment.

pathological appearance of a given lesion very carefully, also giving its description following subsequent cystoscopies. The most accurate description of such changes, however, is definitely inadequate. It is impossible to have a trained artist at one's command at all times. Once treatment has begun, even though a trained artist is available, it is impossible to portray graphically the changes and alterations that many of these lesions assume. Regardless of the accuracy of the artist, the lesion depicted by him is as he observes it and often not as observed originally by the cystoscopist, this error being due to some uncontrollable motion of the patient or the cystoscope which would, of necessity, give a different angle observed by the artist than when observed by the cystoscopist.

To be able to photograph a definite lesion cystoscopically, in its different stages of advancement or regression, would be of material aid in the institution or alteration of any definite and prescribed treatment. Again, in the teaching of students, be they graduates or undergraduates, to be able by means of a photograph to impress clearly upon the minds of the students the appearance of a pathological lesion or anatomical landmark will aid materially in their personal visualization. To the undergraduate student or the beginner in cystoscopy, it is usual that they are entirely lost and grope aimlessly about the

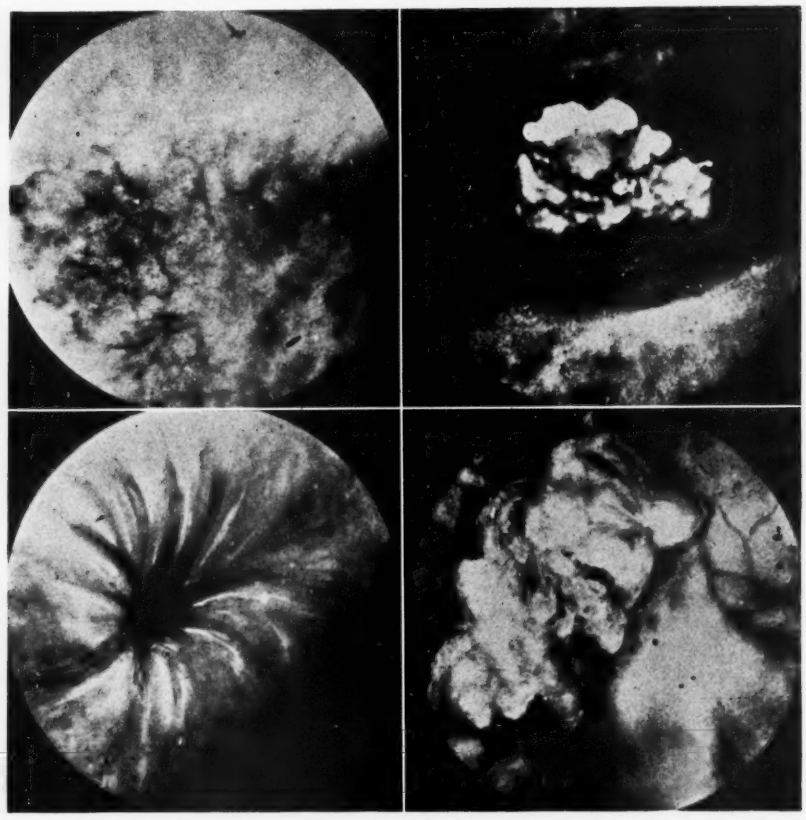

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 3. Cystitis of moderate intensity. Note the dilated veins and the marked congestion of the mucosa.

Fig. 4. Solitary vesical calculus, lying upon the highly inflamed mucosa. The mucosa is so inflamed as to appear as a dark shadow. In the foreground is the interureteric ridge.

Fig. 5. Diverticulous opening of the bladder. Note the striations of the mucosa radiating toward the opening.

Fig. 6. Carcinoma of the bladder. Note its irregular shape. The blood vessels on the floor of the bladder are somewhat enlarged and there is evidence of cystitis to the sides and posteriorly to the tumor mass.

vesical cavity, trying to find a landmark, due to the fact that their perspective is entirely lost. So that in comparison, if a photograph may be shown in conjunction with a line drawing as to the position of the anatomical landmark or a pathological lesion, a definite mental picture is established in the mind of the student.

We have established a permanent exhibit of photographic transparencies at Temple University Medical School, which contains many of the normal landmarks as well as many pathological lesions of the bladder. These transparencies are used routinely in teaching the students at the time of cystoscopy. It is not our purpose to make cystoscopists of every individual, but rather to establish a definite correlation, ideas or impressions, of the normal bladder mucosa and normal vesical landmarks as well as some of the more frequently observed vesical lesions. We believe that photography, in conjunction with visualization of the normal bladder, is a sound method of establishing a permanent impression of normal vesical anatomy, which impression will be carried away by the student after he leaves medical school.

CONCLUSIONS

A photographic record of any vesical lesion is incalculable, either in recording the advancement or regression of such a lesion under treatment.

Cystoscopic photographs are basically sound in teaching students, because the student's perspective is not lost as it is upon observation through the cystoscope.

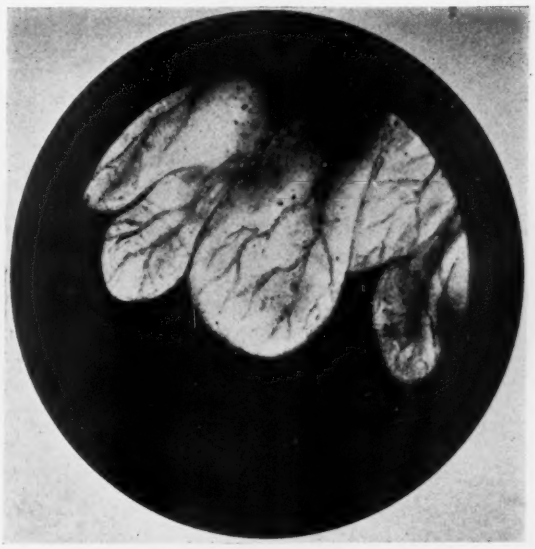

Fig. 7. Polypoid formations on the vesical neck in the female. There is a definite vascularity with a marked congestion at the base of the largest polyp. On occasion, these polyps account for a considerable and unexplained hematuria.

A cystoscopic camera, in the armamentarium of every urologist, would aid materially in accurate depiction of pathological lesions for our textbooks or scientific articles and would make possible a definite and permanent record of the changes or alterations of any given lesion under treatment.

THE COLLOIDAL METALLIC SILVER TAMPON FOR TREATMENT OF RHINITIS, SINUSITIS, ETC.

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CILIARY action, mucous secretion, phagocytosis—these are the three most valuable assistants the physician has in the treatment of almost any infection of the respiratory mechanism, and any method of treatment of rhinitis, sinusitis or other nasopharyngeal affections must be designed to support these powerful factors.

The aim of therapy must be restoration of normal function—*normal mucous secretion*, to maintain an even temperature of underlying tissues and to collect and remove dust particles and other foreign substances entering the nostrils—*normal ciliary action* to help in the evacuation, anteriorly and posteriorly, of normal and abnormal secretions—*normal phagocytosis* to restore the natural defense of the tissues against bacterial invasion.

When these natural defenses succumb temporarily to bacterial invasion, the ear, nose and throat man must assist them with drugs and certain mechanical procedures which have been developed to relieve congestion and permit removal of those irritating factors which are delaying or interfering with normal tissue operation.

The choice of drugs is important. Experience seems to indicate that what is needed is a drug which has antiseptic, tissue-stimulant and cleansing properties, but, unfortunately, drugs with strong antiseptic and bactericidal properties cannot be employed since these, by their destructive action on the tissues themselves, throw an additional burden on the natural defenses instead of aiding them.

Silver, in one or other of its various forms, seems to be almost the only drug available at the moment which most nearly meets the requirements of the case, and for this reason it is the choice of the large majority of otorhinolaryngologists. Voorhees' study (*Eye, Ear, Nose and Throat Monthly*, August, 1934) showed that out of 2,924 eye, ear, nose and throat men replying to the question, "Do you use the silver salts?", 86 per cent stated that they used them in preference to nonsilver agents.

There is every reason to believe that silver still retains a similar prominence in the eye, ear, nose and throat armamentarium. Silver nitrate, a soluble *salt* of silver is naturally quite limited in its application, because of its pronounced caustic, astringent and highly irritating properties, but the colloid type of silver product is almost unlimited in its application.

All such products are foreign to the body and all have low antiseptic values when determined by governmental standards for antiseptics, but they exert their antiseptic action upon micro-organisms found in the nose by continuous action on contact, which results in the liberation of a low but effective concentration of silver ions. This constant antiseptic action is accomplished only by means of tampons which can be left in contact with the chronically congested nasal membrane for as long a period of time as the doctor's individual experience may indicate to be necessary.

In the Proetz technic of application of medication to the sinuses by means of displacement, silver in its various forms is used and is to be commended in those cases in which a simple application of medication is required. This method cannot be employed successfully in all cases.

Sprays are inefficient in that they do not keep tissues in contact with the medication long enough for any special action to take place and merely serve as lubricants. Hypo-

dermic injections into the nasal tissues have not been employed by the author for the treatment of chronically congestive rhinitis.

The main action of the nasal tampon is that of keeping tissues in contact with the drug for a period of time. The mechanical action of the tampon stimulates the columnar epithelium and goblet cells to an increased secretion of mucus, thereby cleansing themselves. This necessitates an increased capillary flow as well as vasomotor activity. The second action is the absorption of the drug employed.

Bearing in mind that contact under pressure is preferable to other procedures in applying the drug, care must be taken in choosing the drug to use upon the nasal tampon. It must be nonirritating and leave no bad after effects.

I always use colsargen, which is a colloidal suspension of metallic silver. This penetrates the mucous membrane by osmosis and acts as an alterative, the latter action occurring as nature endeavors to rid itself of any foreign body, no matter how minute, and in so doing calls for an increased blood supply with phagocytic action. A stimulation of the cells to an increased mucus production also takes place.

Dowling's method of using a well-wrapped, cotton-tipped applicator with argyrol and other silver protein salts, presents too small a surface for any absorption effects, but owing to the pressure exerted by a large tightly wrapped applicator tampon, mechanical stimulation is the only action attained. In the Dowling method, common salt, bicarbonate of soda or any medication would give the same result.

For office use the author prefers a flat tampon of uniform thickness, moistened with colsargen, undiluted, and the excess squeezed out. This tampon is about two inches long and about three-eighth inch wide and something less than one-eighth inch thick. If it is desirable to leave the tampon in place longer than fifteen or twenty minutes, a piece of white or flesh-colored, heavy silk thread is tightly attached to one end of each tampon and tied under the columna. All dangling threads are cut. This is barely noticeable to others and the tampons may be removed by the patient himself at a specified time.

Preparation of a patient prior to the introduction of a tampon is most important. The nasal chambers are sprayed with a 1½ or 2 per cent solution of cocaine hydrochloride and after waiting a few minutes a postnasal cleansing, consisting of a group of alkaline solutions (to dissolve the mucus and separate it from the mucosa) is employed. After this the tampon is prepared. It has been the author's experience to leave the tampons *in situ* for at least fifteen minutes with the use of external heat by means of an infra-red lamp. This seems to stimulate the vasomotor system and cuts the time of treatment in half. During the summer months or if the patient can spare the time, the tampon is left in place for thirty minutes without heat. There is no irritation whatsoever in the use of colsargen. It appears to have the same action at all times. The progress of treatment can be ascertained by inspecting the tampon after its removal and comparing it with the color of the tampon as it was introduced. One will find the color gradually diminishing as the tissues return to normalcy. Naturally, when the tampon is introduced between two tightly covered surfaces the drug would be squeezed out and the tampon appear perfectly white after its removal. This must be taken into consideration in using colsargen as a means of diagnosis.

The author has used colsargen for the past nine years and a study of the records of its use in the treatment of 140 cases of acute and chronic congestive rhinitis and sinusitis, shows that its greatest efficiency has been found in these conditions. When there is a nasal obstruction, this is best corrected before using nasal tampons, but in the event of the refusal of the patient to consent to operation, the colsargen will help in reducing the nasal swelling. This applies also to hypertrophic rhinitis with-

out polypi or polypoid degeneration of the mucous membrane.

The author has introduced colsargen directly into the antra and sphenoidal cavities through a cannula (intra ostia). The affects of this method of treatment of sinusitis have been good but not as marked as when used on tampons. Of course, the sinuses must first be irrigated to remove all mucus.

The advantages in the use of colsargen to other silver solutions are in its uniformity and its readiness for use. It is isotonic and therefore readily absorbable and nonirritating. It does not diminish or destroy ciliary action. Its stain is readily removable with water.

SUMMARY

An effective convenient tampon, prepared with a nonirritating isotonic colloid of metallic silver for the treatment of certain nasal infections has been developed by the author and results of its use in 140 cases of acute and chronic, congestive rhinitis and sinusitis are reviewed.

THE true hemangioma in the oral cavity is most often a fluctuant growth, in contradistinction to the vascular granuloma, which is rather compact.

From—"Pathology of the Oral Cavity"—by Lester Richard Cahn (Williams & Wilkins Company).

METHYL CELLULOSE SOLUTION AS A PLASMA SUBSTITUTE

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THE limited availability and the difficult preparation and handling of blood plasma for the treatment of shock represent an urgent indication for continued research on nontoxic, macromolecular substances capable of re-establishing and maintaining over prolonged periods an adequate total blood volume, a normal cell-plasma ratio and a normal blood viscosity. The colloidal solutions of several nonhematogenous, macromolecular substances, such as gum acacia (Bayliss, 1918), polyvinyl alcohol (Stierlen, 1939; Jorns, 1940), gelatin (Taylor and Waters, 1941) and pectin (Hartman, Schelling, Harkins and Brush, 1941), have been recommended for this purpose. However, none of these substitutes is entirely satisfactory for various reasons, such as difficult sterilization, defective stability, variable purity and chemical composition, antigenicity, toxicity and production of storage phenomena with their associated functional organic disturbances (Hueper; Hueper, Landsberg and Eskridge; Martin and Hueper). If methyl cellulose is presented in the following report as a new plasma substitute, it is done for the purpose of calling attention to a megalomolecular compound which possesses a combination of desirable physicochemical properties lacking in the above mentioned agents.

EXPERIMENTAL PART

Methyl cellulose, which is the methyl ether of cellulose and consists of a long chain of dextrose molecules, is manufactured industrially as a mucilage used extensively for various purposes. It is a white, light, fluffy material which comes in seven grades of viscosity (15, 25, 50, 100, 400, 1,200 and 4,000 centipoise units for a 2 per cent aqueous solution). It is readily soluble in cold water giving a water-clear, viscous, colloidal solution which has a neutral reaction and which gels when heated, finally coagulating into a milky coagulum at higher temperatures (above 65°C.). This heat coagulation of methyl cellulose, which resembles that of blood serum, is reversible, however, on cooling. Solutions of methyl cellulose can, therefore, be sterilized by autoclaving under pressure without losing their physicochemical properties, such as seen with solutions of gum acacia and pectin, which under such conditions develop precipitates and show a marked decrease in viscosity. Methyl cellulose solution is also refractory to infection with the ordinary bacteria, as it does not sustain the growth of these microorganisms. Methyl cellulose is precipitated out of its aqueous solution by the addition of various salts, such as ammonium sulfate, and behaves in this respect similar to the euglobulins of the blood plasma.

The methyl cellulose used in the experimental work is of the highly viscous type, having a molecular weight of well above 50,000. A 0.25 per cent solution of this substance of 20°C. is twice as viscous as water and thus displays a viscosity equal to that of normal human and canine plasma. A colloidal solution of methyl cellulose injected intravenously forms with the plasma proteins a relatively stable emulsion, which can be broken by prolonged centrifugation at high speed.

Before the suitability of methyl cellulose solution as a plasma substitute was studied experimentally, a number of toxicopathological investigations were undertaken to determine the acute and chronic effects of intravenously introduced methyl cellulose

solution upon the blood and the organs of dogs and rabbits. As the results of these experiments will be published in detail elsewhere, they may be briefly summarized here:

The intravenous injection of 10 to 30 cc. of a 5 per cent methyl cellulose solution in normal saline is followed by a marked transitory leukopenia, a prolongation of the coagulation time and an increase in the sedimentation rate, i.e., manifestations of a colloidoclastic crisis, such as is observed after the introduction of foreign colloidal material of various nature and especially of foreign proteins, gelatins, gum acacia, polyvinyl alcohol and pectin. A repeated and prolonged intravenous administration of a 2 per cent methyl cellulose solution is followed by a gradual reduction in the number of erythrocytes and in the amount of hemoglobin, by an increased plasma viscosity, a persistent myeloid leucocytosis, an accelerated conglutination and sedimentation speed of the erythrocytes and a delayed clotting of the blood. The examination of the internal organs of animals thus treated reveals the storage of methyl cellulose in the liver cells, splenic reticulum, kidney and the endothelium of arteries, producing thereby the symptoms of a thesaurosis similar to that seen under corresponding circumstances in animals injected with gum acacia, polyvinyl alcohol, pectin, cholesterol, etc. None of the rabbits and dogs used in these experiments showed at any time any acute symptomatic toxic reaction following the intravenous introduction of the methyl cellulose solution, because this substance is chemically relatively inert and very stable. None of the dogs which received these excessive doses of methyl cellulose and of which some were reinjected with methyl cellulose solution after the course of treatment had been interrupted for four weeks showed any signs of hypersensitivity. Methyl cellulose does not possess, therefore, any antigenic properties. The colloidal osmotic pressure exerted by a 1 per cent methyl cellulose solution is approximately 6 cm. of water and is thus in the neighborhood of that shown by a 1 per cent albumin solution.

After having thus demonstrated the type and extent of the physiological and pathological reactions in the blood and tissues elicited by the introduction of methyl cellulose solution given in moderate as well as excessive amounts and concentrations and after having thus determined the therapeutic limitations of this kind of medication, the efficacy of methyl cellulose solutions in the treatment of shock was investigated. The methyl cellulose solution used in the shock experiments was prepared by dissolving 2 Gm. of methyl cellulose in 100 cc. of physiological saline. This stock solution was diluted to 1 per cent, 0.5 per cent and 0.25 per cent by the addition of a solution of several substances exerting a detoxicating influence upon endogenous or exogenous toxic agents, such as histamine, indol, skatol, aromatic compounds, lead and certain arsenicals. This detoxicant solution contained 2 Gm. of ascorbic acid, 1 Gm. of calcium glucuronate, 1 Gm. of glycine and 0.5 Gm. of cysteine hydrochloride. This solution, which is moderately hypertonic, was always freshly prepared, as it disintegrates within the course of several hours to a noticeable degree following its neutralization by the addition of n/10 sodium hydroxide. The effectiveness of these detoxicants against histamine and other toxic biogenic amines was demonstrated in separate experiments (Martin, Rennebaum and Thompson).

This combination of a colloidal solution of a macromolecular substance with detoxicating agents was chosen for the following reasons: The most important symptom of the syndrome of shock is the hemoconcentration caused by an abnormal vascular and particularly, capillary permeability, permitting the escape of water, crystalloids, colloids, and finally also of cellular elements from the blood, producing thereby a collapse of the circulation and an anoxemia of the tissues. The first and basic requirement of any shock therapy is, therefore, the restoration of the disturbed water balance

of the blood. The water balance of the plasma and thus the total blood volume is normally controlled by the following factors: (1) the colloidal osmotic pressure of the macromolecular colloids, i.e., the various proteins, contained in the plasma; the size of this pressure depends upon the amount and the ratio of the various proteins; the relatively small molecular albumins are responsible for the major portion of it, while the larger molecular globulins and especially fibrinogen account for only a minor portion of it; (2) the water retaining power of these hydrophilic colloids; (3) the osmotic pressure exerted by the numerous crystalloids; (4) the permeability of the vascular wall; and (5) the filtration pressure of the blood, which in turn depends upon the blood pressure.

The immediate aim of any shock therapy must be twofold: (a) a restoration of an adequate total blood volume by the introduction of sufficient quantities of a colloidal solution of a hydrophilic macromolecular substance whose molecule is so large that it does not readily pass through the excessively permeable vascular wall and which through its water retaining properties is capable of maintaining the blood volume over a prolonged period, until the natural restorative powers of the organism can come into play. It is obvious that under such circumstances the colloidal osmotic pressure of the macromolecular agent can play at best only a minor rôle in this respect because of the especially large molecular size of the colloid required; (b) a re-establishment of a normal vascular permeability by the use of agents which counteract the causative vasculotoxic factors active in shock.

These considerations lead to the adoption of a combination of a solution of a macromolecular colloid with certain detoxicating substances as a therapeutic agent in experimental shock.

Shock was produced in dogs either by the application of dry ice to the skin of the back or by the repeated subcutaneous injection of a histamine solution suspended in oil. The methyl cellulose-detoxicant solution was usually administered repeatedly in individual doses of 120 to 130 cc. In general, equal parts of the two component solutions were combined in the mixture given. The intensity and the course of the shock as well as the effects of the treatment were estimated from the following data obtained in frequent intervals: hemoglobin, number of erythrocytes, volume of packed red blood cells, number of leucoctyes, differential count and coagulation time. These criteria were used in preference to blood pressure determinations, as the comprehensive investigations of Moon have shown that the blood changes represent the more reliable evidence in judging the onset and the severity of a shock and that they precede the lowering of the blood pressure observed in shock. Repeated blood pressure determinations necessitate, moreover, the use of bloody methods and of anesthesia, both factors which may introduce serious experimental errors.

1. Shock by Freezing. After the removal of the hairs from both sides of the back with an electric shaver over an area measuring approximately 12 by 15 cm. on each side the dogs were lightly anesthetized with ether and strapped down upon two oblong bags filled with crushed dry ice and moistened with water to obtain an intimate contact with the skin. At the end of the treatment, which lasted for thirty to forty minutes, the skin and the underlying tissues of the exposed regions were frozen hard to board-like consistency. With subsequent thawing they became first highly red and blotchily hemorrhagic and several hours later showed a bluish purple color and a highly edematous, baggy appearance. This reaction receded in general within the first twenty-four hours and was followed by a diffuse necrotic sloughing of the skin, leaving a large, granulating, ulcerative defect in those dogs which survived for more than a week. There were twenty-one dogs in the experiment, of which eight served as controls receiving no antishock therapy. All dogs which survived the immediate effects

of the shock or which did not die subsequently from secondary complications, such as pneumonia and septicemia, were killed at the end of a fourteen days' period. Table 1 presents the hematological findings observed in four representative members of both the experimental and control groups of this series of dogs. (Table 1.)

dogs died within the first seventy-two hours, while only one out of the thirteen treated dogs died during this period of acute shock action.

II. Shock by Histamine Injection. In view of the fact that it was found difficult to produce a progressive and satisfactorily standardized type of fatal shock by freez-

TABLE I

Dog	Before			2–4 Hours			5–7 Hours			8–10 Hours			24 Hours			48 Hours		
	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.
Experimental																		
518	4.81	43.0	10.7	7.39	60.5	21.0	7.40*	59.5	31.0	6.44*	54.0	15.2	5.61	46.0	28.1	6.73	45.0	29.8
527	6.56	49.6	13.8	6.65	56.0	28.8	7.46	60.0	22.2	8.28*	63.0	33.3	6.46*	49.0	35.0	6.40	42.0	25.2
529	7.31	50.0	11.0	9.50	69.5	21.6	10.3*	71.0	24.8	8.24*	65.0	9.1	6.95	54.5	18.8	6.52	49.5	27.9
541	7.37	57.5	16.5	8.82	62.0	37.9	9.07*	63.5	38.0	8.31	62.0	37.9	6.77	52.0	24.3	5.68	45.5	25.0
Control																		
517	8.02	59.7	14.4	9.91	78.5	23.6	9.67	75.0	30.5	8.33	73.0	31.7	8.99	68.0	26.9	9.54	72.5	33.8
522	7.94	56.3	24.2	8.43	66.5	23.0	8.29	59.5	26.0	7.12	62.0	26.8	8.54	71.0	26.0	7.18	56.0	24.2
524	7.30	47.0	12.5	8.21	58.0	20.8	7.64	56.0	20.4	7.24	55.0	26.4	7.57	57.0	16.6	6.91	50.0	24.2
539	7.50	53.7	17.7	8.47	61.0	18.1	7.42	60.5	22.2	7.04	59.0	25.2	8.01	60.0	21.8	7.55	49.0	31.1

* Injection of methylcellulose solution after this count.
E. Erythrocytes.
V.P.E. Volume of packed erythrocytes.
L. Leucocytes.

An analysis of the data recorded in Table 1 shows that the freezing of large areas of the skin causes a moderate to considerable but transitory erythrocytosis and leucocytosis, as well as a temporary increase in the volume of packed blood cells, usually lasting twenty-four hours, after which time normal or sometimes even slightly subnormal values are again attained in the control dogs. On the other hand, if at the height of these reactions, i.e., five to ten hours after the freezing, methyl cellulose solution is administered, there occurs a sudden drop in the pathological increases in the number of erythrocytes and the packed blood cell volume leading rapidly to values which are considerably below the original ones and which persist for at least forty-eight hours. The time of hemoconcentration is thus cut short and a prolonged hemodilution is produced. This apparent beneficial effect exerted by the treatment given upon the hemoconcentration is reflected also by the survival rates of the two groups, as five of the eight control

ing, the experimental investigations were extended to shock caused by the action of subcutaneously administered histamine. Inasmuch as it appeared desirable to imitate as closely as possible the conditions present in traumatic shock in man, histamine base or hydrochloride was injected in refracted doses given at intervals of one to three hours and incorporated in an emulsion of peanut oil and lanolin, in order to slow up its absorption. From two to five injections were made. The individual dose ranged from 0.03 Gm. to 0.003 Gm. of histamine per kg. of body weight, while the total dose varied between 0.03 Gm. and 0.0075 Gm. per kg. of body weight.

The symptoms of shock, such as vomiting, diarrhea (often hemorrhagic), rapid labored respiration, rapid pulse, foaming at the mouth, greatly increased thirst, and prostration, developed gradually under this management within three hours after the start of the treatment. The therapeutic measures were instituted when either the blood changes or severe symptomatic mani-

TABLE II

Dog	Histamine Dose, Gm.	Before			2–4 Hours			5–7 Hours			8–10 Hours			24 Hours			48 Hours		
		E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.	E.	V.P.E.	L.
Experimental																			
602	0.06	6.64°	52.0	27.1°	7.35			7.68*°	55.0	31.0*°	6.52*	49.5	25.6*	6.23	48.0	22.8	5.33	41.5	28.3
583	0.06	7.84°	54.5	13.2°	9.32°	59.0	20.1°	9.05*	75.0	28.6*	7.43*	53.5	16.4*	6.63	52.0	21.9	6.64	51.5	13.2
622	0.075	6.78°	54.5	15.4°°°	8.03°°	59.0	26.7	8.24*	59.0	29.2*	7.81*	53.0	4.2*	6.46	39.0	10.8	6.66	45.0	10.9
639	0.092	6.95°°°°	47.5	18.0°°°	8.50*	55.0	27.2°	8.03*	50.0	27.9*	6.95*	45.0	27.9*	5.90	35.0	13.6	5.81	39.0	22.0
591	0.095	6.18°	47.5	5.1°	6.94°	49.0	11.1°	7.12°	55.0	17.2°*	*6.35*	48.0	18.9*	6.05	46.0	15.6	4.96	40.5	13.8
575	0.07	7.62°	50.0	14.3°	8.35°	60.5	22.9°	8.57*	56.5	26.1*	6.25*	49.0	24.9*	5.63	41.0	18.0	6.17	42.3	12.7
665	0.195	5.19°°°°	37.0	24.3°°°°	5.85°	37.5	39.2°	6.02*	39.0	55.2	4.84*	38.0	52.1*	5.17	36.0	34.7	†		
612	0.09	5.92°	51.5	10.8°	7.07°	49.0	16.0°	7.39°	49.5	20.8°	6.67*	49.0	12.7*	7.29	43.5	13.2	6.83	45.0	22.4
	0.10	5.11°°°°	42.0	9.8°°°°	6.38	45.0	16.6	6.4*	42.0	14.5*	5.57*	38.0	26.8	5.87	37.0	15.6	6.09	37.3	9.9
631	0.12	6.60°°°	54.0	10.1°°°	9.06	58.0	17.9	6.74°	48.5	18.2°	6.01*	39.0	15.2*	6.15	44.0	9.9	†		
	0.15	5.67°°°	41.5	7.8°°°	6.05°	42.0	7.4°	6.18°	42.0	7.0°	*4.86*	38.0	*8.8*	4.46	37.0	8.8	†		
Controls																			
617	0.18	7.16°	60.6	6.05°	8.02°	66.0	11.4°	8.27	66.5	30.4	9.25	72.5	30.2	†					
574	0.08	7.98°	54.0	13.4°	8.00°	54.0	16.0°	8.82	57.5	24.8	8.44	51.0	34.4	†					
586	0.052	7.57°	56.0	13.6°	8.61°	59.0	17.6°	8.35	73.0	21.7	9.50	75.0	27.6	†					
603	0.175	6.01°	47.5	9.6°	7.16°	54.0	13.0°	6.70	53.0	17.4	7.22	54.0	21.3	7.30	51.5	19.9	5.65	41.0	10.4

* Injection of methyl cellulose solution.
† Death.
E. Erythrocytes.
V.P.E. Volume of packed erythrocytes.
L. Leucocytes.
° Injection of histamine.

festations indicated the existence of a severe and progressive shock. A total of forty-two dogs was used in this experiment. Seven of these dogs received only histamine and served as controls.

Table II presents the observations made in four control dogs and ten experimental dogs treated with methyl cellulose-detoxicant solution. They were selected from the total number as representative examples. (Table II.)

The data recorded in Table II show that the repeated injection of methyl cellulose-detoxicant solution in adequate quantities and suitable intervals exerts a decidedly favorable effect upon the hemoconcentration, the hyperleucocytosis and the volume of the packed erythrocytes elicited by the subcutaneous injection of histamine. The considerable and prolonged hemodilution following upon this type of therapy is a striking feature. Its life saving character appears to be evident from the fact that two dogs which had developed a leucocytosis of 55,000 and 61,000 cells and thus, according to Moon, were well within the fatal range of shock leucocytosis, survived.

COMMENT

Observations made in dogs subjected to shock by freezing or by the subcutaneous injection of histamine indicate that the repeated intravenous administration of a moderately hypertonic solution of methyl cellulose fortified by the addition of several detoxicating substances (ascorbic acid, calcium gluconate, cysteine hydrochloride and glycine) causes a rapid reduction of the hemoconcentration and leucocytosis followed by a stabilization of the number of erythrocytes and of the volume of the packed red blood cells at or below the initial level for periods extending for more than forty-eight hours. Simultaneous with this improvement of the blood changes associated with shock, there occurs a corresponding beneficial effect upon the action of the heart, evidenced by the appearance of a slowed, strong pulse, and upon the general vitality. The injection of a 0.5 to 1 per cent solution of methyl cellulose into the jugular vein does not elicit any acute untoward reactions even when administered at great speed. Mention may be made, however, of the fact that the intravenous injection of an excessively viscous solution of methyl cellulose (4 to 5 per cent) is inadvisable, as such a medication causes a sudden and marked temporary increase in the viscosity of the blood which accentuates the circulatory embarrassment already existing in shock.

It may be noted also that attempts made to follow the changes in total plasma volume by the photo-electrical colorimetric determination of the injected dye (T 1824) failed, as highly erratic results were obtained. Thus, similar observations made with this method in shocked animals by Magladery, Solandt and Best could be confirmed. The abnormal permeability of the capillaries present in shock interferes evidently with the proper retention of the dye in the blood.

The main objection which may be raised against the use of methyl cellulose for the purpose discussed is represented by its retention in various organs, especially the liver, spleen and kidney. However, it shares this quality with several of the other agents (gum acacia, pectin, polyvinyl alcohol) proposed as blood substitutes, which also are stored in these organs and interfere thereby with their normal functional activity, particularly the regeneration of plasma proteins by the liver. Although this drawback bars methyl cellulose solution from any future therapeutic use in the control of hypoproteinemia, it does not militate against its employment as a plasma substitute in the emergency treatment of shock, when plasma may not be available. The existence of several types of methyl cellulose differing in molecular weight offers, moreover, the opportunity to choose from a series of macromolecular agents, with gradated colloidal and physicochemical properties as to colloidal osmotic pressure and vascular permeability, that particular compound which is least hazard-

ous and most suitable and efficacious as a nonhematogenous plasma substitute.

The advantages which methyl cellulose possesses may be summarized as follows:

1. Methyl cellulose is a substance readily available from industrial sources in this country and does not need to be imported, such as gum acacia.

2. Methyl cellulose is obtainable as a relatively pure substance readily soluble in water giving a water-clear, neutral, stable solution, which is not changed in its physicochemical properties by heating, such as occurs with solutions of gum acacia, pectin and gelatin.

3. Methyl cellulose solution is refractory to bacterial infections and can, therefore, be handled under emergency conditions with greater safety than solutions of gum acacia, pectin and gelatin.

4. The chemical uniformity, purity and stability of methyl cellulose guarantees the production of a solution of standardizable qualities and contrasts with the chemical variability of gum acacia and pectin and their frequent contamination with toxic exogenous substances.

5. Methyl cellulose is nonantigenic and does not elicit, therefore, any hypersensitive reactions, such as produced by gum acacia and fish gelatin.

CONCLUSIONS

Dogs subjected to shock produced by freezing or by the subcutaneous injection of histamine show a rapid reduction in hemoconcentration and a subsequent prolonged moderate hemodilution following upon the intravenous injection of a 0.5 to 1 per cent solution of methyl cellulose fortified by the addition of several detoxicating chemicals (ascorbic acid, cysteine hydrochloride, calcium gluconate, glycine).

The relatively rapid administration of such a solution is invariably tolerated without any acute untoward reactions.

The potential therapeutic use of this agent in man is subject to the same limitations as those applying to other macromolecular colloidal agents which are used as plasma substitutes (gum arabic, polyvinyl alcohol, pectin) and which produce upon long repeated introduction of excessive amounts hazardous storage phenomena.

Methyl cellulose and its aqueous solution possess a number of physicochemical qualities which make them superior to other nonhematogenous macromolecular blood substitutes for the restoration and maintenance of the blood volume reduced under the conditions of shock.

REFERENCES

1. Bayliss, W. M. Intravenous Injections in Wound Shock. New York, 1918. Longmans, Green & Co.
2. Hartman, F. W., Schelling, V., Harkins, H. N. and Brush, B. Pectin solution as a blood substitute. *Ann. Surg.*, 114: 212, 1941.
3. Hueper, W. C. Organic lesions produced by polyvinyl alcohol in rats and rabbits. *Arch. Path.*, 28: 510, 1939. Experimental studies in macromolecular pathology. *Pharmaceut. Arch.*, 12: 49, 1941. Experimental studies in cardiovascular pathology. III. Polyvinyl alcohol atheromatosis in the arteries of dogs. *Arch. Path.*, 31: 11, 1941. Experimental studies in cardiovascular pathology. IV. Methyl cellulose atheromatosis and thesaurosis. *Arch. Path.*, 33: 1, 1942. Organic lesions produced by the intravenous administration of pectin solutions to rabbits. (To be published.)
4. Hueper, W. C., Landsberg, J. W. and Eskridge, L. C. The effects of intravenous and intraperitoneal introduction of polyvinyl alcohol solutions upon the blood. *J. Pharm. & Exper. Ther.*, 70: 201, 1940.
5. Magladery, J. W., Solandt, D. Y. and Best, C. H. Serum and plasma in treatment of hemorrhage. *Brit. M. J.*, 2: 248, 1940.
6. Jorns, G. Zur Frage des Kolloidzusatzes zu isotonischen Kochsalzlösungen und anderen Blutersatzflüssigkeiten. *Klin. Wchnschr.*, 19: 444, 1940.
7. Martin, G. J. and Hueper, W. C. Biochemical basis of atheromatosis. (To be published.)
8. Martin, G. J., Rennebaum, E. H. and Thompson, M. R. Therapeutic and prophylactic detoxication of histamine, indole and guanidin. (To be published.)
9. Moon, V. H. Shock and Related Capillary Phenomena. New York, 1938. Oxford University Press.
10. Stierlen, G. Über ein synthetisches Kolloid (Polyvinylalkohol) als Zusatz zu hypertonischen Lösungen und Blutflüssigkeiten. *Ztschr. f. d. ges. exp. Med.*, 106: 201, 1939.
11. Taylor, H. D. and Waters, E. T. Isinglass as a transfusion fluid in hemorrhage. *Canad. M. A. J.*, 44: 547, 1941.

TREATMENT OF FEMALE MENOPAUSE WITH METHYL TESTOSTERONE AND STILBESTROL*

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THE use of male sex hormone in female menopause has been reported by various observers. Kurzrok, Birnberg, and Livingston described a large series of women successfully treated for the complaints of menopause by administration of 40 to 50 mg. of testosterone propionate weekly by injection. Efforts have repeatedly been made to prevent recurrence of bleeding in women at the menopause, particularly in those women who had undergone *x*-ray or radium therapy for functional menorrhagia or metrorrhagia. It has been frequently demonstrated that the continued treatment of female menopause with estrogenic hormones will produce irregular uterine bleeding. In an effort, therefore, to prevent this undesirable consequence, we have used a combination form of treatment, using methyl testosterone and stilbestrol orally. Detailed description of properties and actions of stilbestrol are unnecessary at this time, as they have been clearly elucidated in a previous publication by Kurzrok, Birnberg and Weber, as well as other investigators.

Methyl testosterone, 17-methyl Δ^4 androstenol-17 (trans)-one-3, is a synthetic, crystalline, chemically pure compound, practically insoluble in water, but soluble in alcohol, ether, and other organic solvents, and melts at 165°C. It differs chemically from testosterone propionate, and its metabolism is probably not identical, the additional group acting to prevent its destruction or modify its absorption in the gastrointestinal tract. Examples of its different action are: (1) ability to restore the depressed metabolic rate in eunuchoids, and (2) a greater degree of body fluid and salt retention.

Shapiro found that methyl testosterone induced ovulation in Xenopus laevis, the South African clawed frog.

Duffy and Corsaro determined that methyl testosterone administered by mouth, in doses of 25 mg. at intervals of four hours for six doses, produced inhibition of lactation postpartum comparable to that obtained with 50 to 75 mg. of testosterone propionate administered subcutaneously.

Selye demonstrated that various steriod hormones, especially desoxycorticosterone acetate and progesterone produce deep anesthesia in rats and mice if injected into the peritoneum whence they can be rapidly absorbed. Methyl testosterone, in doses of 50 mg. administered in this way, produced deep anesthesia in 50 per cent of the animals used.

Goldzieher mentions the use of methyl testosterone in menorrhagia, in doses of 25 mg. twice daily orally, but does not state results.

McCullagh found that oral methyl testosterone is effective therapy in eunuchoidism. In terms of clinical symptoms its effectiveness as compared to testosterone propionate injections approximates 3 or 4 to 1. The metabolism of methyl testosterone differs from that of testosterone propionate in that clinically effective doses of the propionate are followed by a rather marked increase in urinary androgens. With methyl testosterone, this sequence does not occur to the same extent. Methyl testosterone has the power to raise the basal metabolic rate. A dosage of 25 to 75 mg. per day was employed and well tolerated. Gain in weight in some cases has been a prompt and rather striking feature. On doses of 75 mg. a day, weight gains on the

* From the Gynecological Endocrine Clinic, Greenpoint Hospital, Brooklyn, New York.

order of ten pounds in two weeks have been seen. One man voluntarily discontinued taking the drug because of an uncomfortable sense of bloating, associated with a gain of thirteen pounds in weight in twenty-three days. In another case, a similar gain in weight was associated with severe headache. This patient had undergone the removal of a pituitary tumor the month before, and it was suspected that the headache was caused by an increase in intracranial edema. Such increases in body weight suggest that the effect of methyl testosterone on sodium, chloride and water retention is similar to that seen following the use of testosterone propionate and other related steroids.

Tager and Shelton, and Kearns found that methyl testosterone is practical and efficacious in oral administration. In patients with marked testicular deficiency, who were previously treated with testosterone by various routes, it duplicated and maintained all of the beneficial effects. The ill effects are negligible, slight gastric irritation being the only unpleasant by-effect observed. Approximately four to six times the inunction and injection dosage is required.

Miescher and Tschopp have demonstrated that methyl testosterone is considerably more active by mouth than testosterone, androstanediol, androstenedione, testosterone propionate, and androsterone in castrated male rats as shown by the increase in weight of the seminal vesicles and prostate. They suggested that possibly greater protection of the active hydroxyl group from fermentative influences in the alimentary canal was acquired from the adjacent methyl group. Foss reported three cases of eunuchoidism and hypogonadism treated by methyl testosterone administration with excellent results. One patient complained of some symptoms of slight nausea, anorexia and dyspepsia, which were relieved by a little alkaline mixture. The effect of methyl testosterone was twice that of a similar amount of testosterone by mouth.

Biskind et al. treated seven typical cases of eunuchoidism, by implanting pellets of crystalline methyl testosterone and in 1 case crystalline testosterone propionate. Total dosage was between 83 and 180 mg. compressed into pellets averaging 5 to 6 mg. each. The duration of effectiveness averaged seven to eight weeks. Testosterone propionate pellets seemed somewhat more potent clinically, but methyl testosterone was easier to prepare and safer to administer. The absorption from each pellet of methyl testosterone was approximately 0.10 to 0.17 mg. per day. The high melting point of methyl testosterone pellets permits sterilization in the pressure autoclave, thus materially reducing the possibility of contamination. The experience indicates that the uniform continuous absorption from such pellets is more efficient than injections of the hormone in oil so that about one-fifth of the dosage is required to obtain similar results. The eventual cost of continuous treatment should be less, therefore, and the interval of about seven weeks between implantations is a decided improvement over injections two to seven times weekly.

We have treated sixteen cases of female menopause, both spontaneous and surgically produced, by the administration of methyl testosterone and stilbestrol orally. Three women suffered from arthralgia, and three from pruritus vulvae, in addition to the flushes, headaches and sweats of female menopause.

Dosage varied from 5 to 25 mg. of methyl testosterone daily, usually 25 mg. being administered, and 2 to 3 mg. of stilbestrol daily. The duration of treatment was between one and six months. Total dosage ranged between 750 to 3565 mg. of methyl testosterone and 60 to 450 mg. of stilbestrol.

Improvement or complete relief from symptoms of menopause was obtained in all cases. Two cases of pruritus vulvae were benefited and one was unimproved. The three cases of arthralgia were improved in varying degrees.

Vaginal smears and acidity determinations were done at intervals of one to two weeks. The vaginal smear demonstrated an original reduction of epithelial reaction of the mucosa, with a secondary improvement, after several weeks. However, there were very few plus 4 vaginal smear readings. There was no corresponding change in vaginal acidity noted. The vaginal hydrogen ion concentration in some cases was reduced, in others increased. No correlation between vaginal hydrogen ion concentration and vaginal smear was apparent during therapy in this series.

Absence of uterine bleeding, or its extent and amount when present were carefully studied. Five cases of spontaneous menopause continued to menstruate with fair regularity with no apparent change in duration or amount. Two cases of spontaneous menopause who had bled considerably while receiving estrogenic substitution therapy, had only moderate bleeding during combined therapy. Three women with spontaneous menopause with an amenorrhea of from five to thirty-six months had no bleeding during treatment. Five patients who had undergone hysterectomy and bilateral oophorectomy had no vaginal bleeding. One patient in whom a bilateral oophorectomy had been performed two years previously suffered no bleeding during the course of medication.

There was little variation in weight recordings, the greatest change being a loss of eight pounds over a period of four months in one patient.

In one woman there was a lowering of voice for several weeks following the administration of 1,565 mg. of methyl testosterone and 142 mg. of stilbestrol over a period of six months. This disappeared after withdrawal of medication. There were no other evidences of masculinization such as hirsutism, enlargement of the clitoris or changes in the breasts, in our series.

Reactions were noted as follows: four patients suffered from anorexia or nausea; one patient had severe nausea with vomiting after one week of treatment necessitating discontinuation of therapy; one patient had a generalized papular eruption with pruritus after seven weeks of treatment. The total dosage given was 1,250 mg. of methyl testosterone and 100 mg. of stilbestrol. The complication cleared up rapidly on withdrawal of the drugs; one patient suffered from pruritus vulvae with atrophy of the labia majora. The total dosage administered was 1,575 mg. of methyl testosterone and 150 mg. of stilbestrol.

We believe that these by-effects are the result of stilbestrol rather than from methyl testosterone, especially since the type and frequency of reactions are similar to those seen with stilbestrol alone.

SUMMARY

1. A series of sixteen women treated for menopausal complaints is reported.

2. Therapy consisted of a combination of methyl testosterone and stilbestrol.

3. Dosage varied from 5 to 25 mg. of methyl testosterone and 2 to 3 mg. of stilbestrol daily.

4. Symptoms of menopause were ameliorated or controlled.

5. The vaginal smear demonstrated an original reduction of epithelial reaction of the mucosa with secondary improvement.

6. No correlation between vaginal hydrogen ion concentration and smear was apparent in this series.

7. There was no instance of excessive uterine bleeding during combination therapy.

8. One patient showed a transient lowering of voice during therapy. No other evidence of masculinization was noted.

9. By-effects of anorexia, nausea and vomiting occurred in a few cases. Pruritus and a papular eruption each was noticed in a single case.

It is our belief that a combination therapy, such as outlined above, is of considerable advantage in certain selected cases of female menopause.

We wish to express our thanks to the Schering Corporation for the use of their

product, Methyl Testosterone, and to the Winthrop Chemical Co. for the use of their product, Stilbestrol (Cyrestrone).

We wish to express our appreciation to Dr. Charles H. Birnberg for his co-operation and kindness.

REFERENCES

Biskind, G., Escamilla, R. and Lisser, H. *J. Clin. Endocrinol.*, 1: 38, 1941.
Duffy, P. and Corsaro, J. *J. A. M. A.*, 116: 33, 1941.
Emmens, C. and Parkes, A. *J. Endocrinology*, 1: 323, 1939.
Foss, G. L. *Brit. M. J.*, 2: 11, 1939.
Goldzieher, M. A. *Med. Rec.*, 153: 47, 1941.
Kearns, W. M. *J. Clin. Endocrinol.*, 1: 126, 1941.
Kurzrok, L., Birnberg, C. and Livingston, S. *J. Endocrinol.*, 3: 347, 1939.
Kurzrok, L., Birnberg, C. and Weber, H. (To be published by *Am. J. Surg.*)
Miescher, K. and Tschopp, E. *Schweiz. med. Wchnschr.* 68: 1258, 1938.
McCullagh, E. *Cleveland Clin. Quart.*, 7: 226, 1940.
Selye, H. *Proc. Soc. Exper. Biol. & Med.*, 46: 116, 1941.
Shapiro, H. A. *J. Endocrinol.*, 1: 1, 1939.
Tager, B. and Shelton, E. *J. Clin. Endocrinol.*, 1: 131, 1941.

Sarcomas of the stomach vary in their macroscopic appearance depending on cellular type, cellular activity, location, and degenerative change. Lymphosarcomas usually differ from other sarcomas of the stomach in that they are for the most part endogastric.

From—"Carcinoma and Other Malignant Lesions of the Stomach"—by Waltman Walters, Howard F. Gray and James T. Priestley (W. B. Saunders Company).

TECHNIC OF INSERTING THE STEINMAN PIN*

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ON the Orthopedic Division of the New York City Hospital we still find many uses for the Steinman pin in the treatment of fractures. In the course of our experience we have made some useful modifications in the technic of inserting these pins which we hope may be of interest to other surgeons.

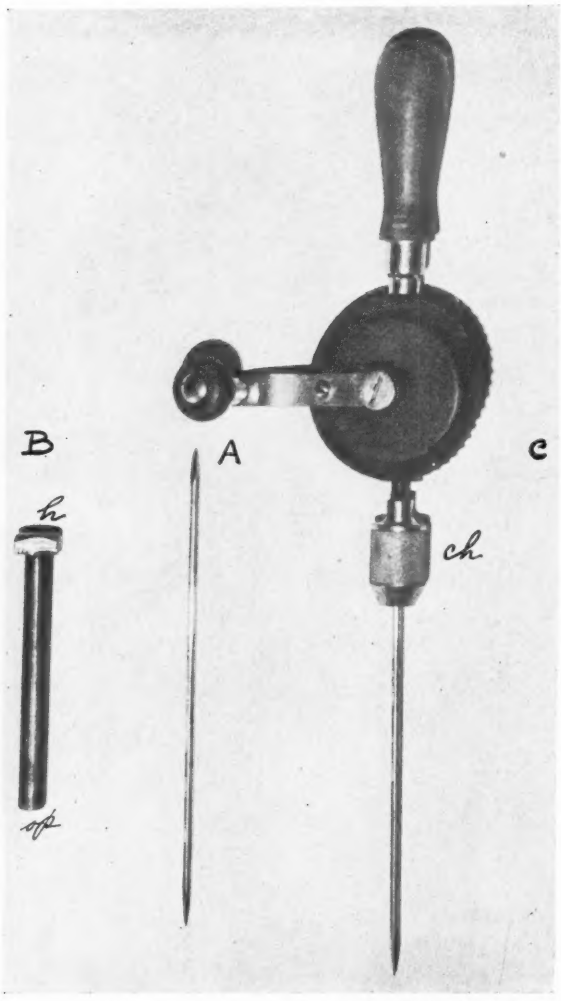

FIG. 1. A, Steinman pin; B, cap; C, hand drill with pin in position for insertion into bone; h, head of cap; op, open end of cap which fits over Steinman pin; ch, universal chuck which holds Steinman pin.

Our average pin is a chromium-plated shaft of steel approximately 7 inches long $\frac{5}{32}$ of an inch in diameter, squarely bevelled to a point at one end and usually bluntly pointed at the opposite end. (Fig. 1A.)

This pin may either be drilled or hammered into a bone. Hammering has the advantage that the pin fits very snugly into the hole in the bone and is less apt to slide from side to side. On the other hand, when the pin is drilled into position we do not have the jolting shock of the hammer blows which, in addition to causing some discomfort, tends at times to displace the fracture fragments.

To hammer a Steinman pin into place we make use of a Steinman pin cap. (Fig. 1B.) This consists of a square headed machine bolt $4\frac{1}{4}$ inches long, $\frac{7}{8}$ of an inch in diameter, with a $\frac{6}{32}$ of an inch hole drilled to a depth of $1\frac{1}{4}$ inches at the far end. The cap is placed over the blunted end of the Steinman pin (or even a sharp end if both ends happen to be sharpened) so that it covers the proximal end of the pin for about an inch. With an ordinary surgical hammer the pin is driven into place by striking the squared head of the bolt.

To drill the pin into place we first used the small handle which fitted over the blunt end of the pin so that it can be rotated. This was very difficult and awkward because of the small size and poor purchase of the handle. If one takes the ordinary Steinman pin and fits it into a standard-sized hand drill with a universal chuck (C) it becomes an easy matter to drill the Steinman pin through any type of bone. Because of the squared point of the pin it almost acts like a steel drill in penetrating bone. In this way, one can insert the pin without disturbing the fracture fragments.

* From the Surgical Service of Lyman W. Crossman, M.D.

Case Reports

SPLENIC ABSCESS WITH DRAINAGE AND RECOVERY*

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SPLENIC abscess occurs with considerable frequency as is demonstrated by numerous references to the condition found in the literature. In 1879, Blanc presented a study of splenic abscess of malarial origin.[1] Grand-Moursel,[2] in 1885, collected fifty-seven cases; Kuttner,[3] in 1907, reported on 116 cases; in 1924, Silvestrini collected 150 cases; Wallace in South Africa reported to Billings that he had "either operated on or found at autopsy well over 100 cases of splenic abscess" and Billings himself reported on fifty-one cases in 1928;[4] and Walker[5] reviews thirty cases including one patient he personally treated surgically. There are numerous other contributions on the subject.

Abscess of the spleen frequently develops from latent systemic infection or as metastasis from some septic focus elsewhere in the body such as phlebitis, otitis, carbuncle, etc. Most writers on the subject seem to agree on the following etiologic classification with slight individual variation: (1) traumatic, (2) metastatic, (3) abscess following suppuration in the vicinity of the spleen.

A traumatic abscess of the spleen is chiefly the result of a suppurating, perisplenic hematoma following injuries producing a rupture of the spleen. Hematomas offer a favorable medium for the bacterial growth of germs in the general circulation or obvious foci of infection. Inlow[6] reported on twenty-four cases in which the etiological factor was rupture of the spleen with secondary infection of the hematoma. Stab wounds or accidental punctures of the spleen may carry infecting organisms which produce an abscess and this is illustrated in one of Walker's cases in which an injury of the spleen took place in the course of nephrectomy for an infected kidney. Several observers believe that about 15 per cent of splenic abscesses result from a traumatic factor.

The greater percentage of splenic abscesses are concerned with *metastatic phenomena*. These following local or general infection. It seems that infection of the digestive tract is in particular a source, chiefly because of the high incidence of splenic abscess following typhoid reported by different writers to vary from 14 per cent to as high as 70 per cent. Our case followed phlebitis. Dr. Eliason reported a case following a peritonsillar abscess. Dr. Billings' case followed a carbuncle. A great variety of infectious conditions have preceded abscess of the spleen. The earlier writers reported malarial infection to be a prominent source of splenic abscess. Bacterial abscess is a common forerunner of this condition and abscess of the spleen has developed during the course of or following pneumonia, influenza, streptococcic infections, appendicitis, puerperal infections, intestinal amebiasis, the infectious diseases, anthrax, deep infected burns, otitis, mastoiditis, etc. Abscess from an

* From Surgical Division "A" of The Jefferson Medical College and Hospital, Philadelphia, Pa. Read before the Philadelphia Academy of Surgery, November 3, 1941.

unknown cause or from an undetermined infection has occasionally been seen.

Abscess following suppuration in the vicinity of the spleen or by *contiguity* is not a common finding but represents a complication of a disease process in a related organ which extends itself to the splenic area and then into the substance of the spleen. This is illustrated by reported cases of abscess following rupture of a gastric carcinoma into the spleen, rupture of a hepatic abscess into the splenic area, perforation of a carcinoma of the colon into the spleen and secondary involvement of the spleen from a perinephric abscess.

A variety of conditions seem to predispose to abscess of the spleen and these include typhoid, malaria, tuberculosis, diabetes, local fatty degeneration, infarct, movable spleen, torsion, hemorrhagic infiltration and a "dysequilibrium between specific cellular action and general biological action due to intense functional hyperactivity in an infectious disease"[1] as in typhoid or any condition in which general or local resistance is diminished.

The pathogenesis of the condition is related to the etiological factor. As seen from the above paragraphs it may follow a direct route by contiguity or may be hematogenous via the veins and arteries. Embolic infarction is the probable process in the cases of endocarditis and typhoid. E. Calderera suggests that "the inflammatory process begins around the infarcted area and the latter becomes gradually infiltrated and undergoes purulent changes."[8] And this seems to bear out Kuttner in his theory of the occurrence of a "sequestrating" abscess in which particles of splenic pulp of variable size are found in the abscess cavity. While, from a clinical standpoint, a single abscess is usually found, the autopsy reports indicate "that multiple abscesses are more frequently found than the solitary variety."[4] Practically every organism, with the exception of the gonococcus, has been found in splenic abscess.

The symptoms associated with abscess of the spleen vary with the individual case and are somewhat influenced by the causative factor. In certain cases the abscess may be so situated and of such size as to produce no pointed symptoms or it may be clouded by more prominent symptoms of a pertinent process of which the abscess of the spleen is merely a complication. The formation of the abscess may be acute or insidious in onset; it may quickly follow a primary infection; or the interval between its development may vary from a few weeks to a number of years. The location of the abscess will influence the symptoms. If its extension is toward the thorax, there will be diaphragmatic and pleural involvement characterized by pain of varying intensity, located in the left hypochondrium and lower chest, radiating to the back and upward to the left shoulder. If the abscess is located in the anterior surface or the lower pole, the symptoms will be more referable to the abdomen due to peritoneal irritation.

The general symptoms of suppuration such as fever, chills, sweats and leukocytosis are usually seen. Pain and splenic enlargement are usually present. There may be abdominal distention with marked muscular rigidity and tenderness in the upper left quadrant. The expansion of the thorax may be restricted in the lower left area. *X*-ray examination is illuminating, revealing the fixation of a higher left diaphragm, the displacement of surrounding organs by barium enema and the exclusion of the kidneys by pyelography. Exploratory puncture for diagnostic purposes is used by some but carries a possible hazard.

Treatment of the condition, in selected cases, is surgical. Splenotomy is the procedure most frequently employed and possibly offers the greater prospect for recovery. Splenectomy is the choice of operation in those cases which are made feasible by finding the spleen fairly free of adhesions and in which the condition of the patient justifies this more extensive technical operation. Several writers suggest the following surgical approach to a splenic

abscess, the selection of which is to be determined by the factors present in the individual case: (1) transpleural, (2) abdominal and (3) retroperitoneal. In our case we used the abdominal route through a left upper rectus incision which, in the majority of instances, seems to offer the better exposure for the work to be done.

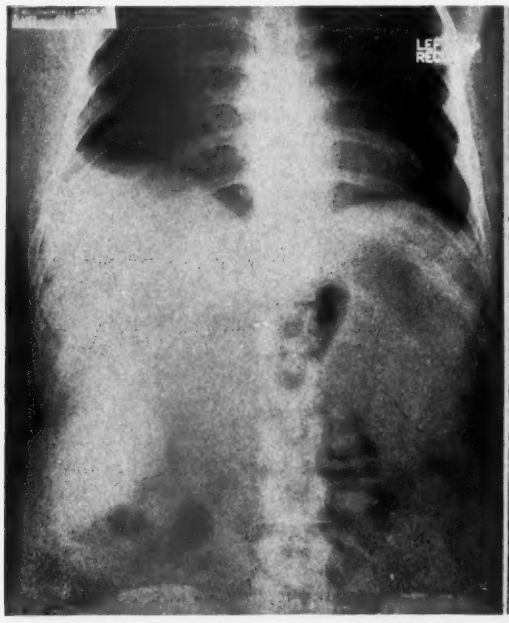

Fig. 1. This shows the *x*-ray picture of a flat plate of the abdomen. A large soft tissue mass is present in the upper left hypochondrium.

Fig. 2. The barium enema shows the marked displacement of the colon.

The prognosis is in definite relation to the condition with which the abscess is associated. Most of the cases in which no operation is performed terminate fatally. Different observers report varying mortality rates but with our present-day facilities for study, the condition of splenic abscess can be diagnosed and successfully treated in the majority of cases.

CASE REPORT

E. I., a white housewife, forty-eight years of age, was referred by Dr. Frank Jamison of Gloucester, New Jersey, to the private service of Dr. William T. Lemmon at the Jefferson Hospital on July 29, 1938. Her chief complaints were pain in the upper left quadrant of the abdomen for three weeks, fever and flatulent indigestion for six weeks. She was always in good health until her present trouble began with the exception of the "usual diseases of childhood." She had borne one child with a normal labor; she had no miscarriages or abortions, and she gave no history of previous cardiorespiratory, gastrointestinal or genitourinary symptoms. Her family history was irrelevant.

Seven weeks before admission she had an operation in another hospital for the removal of a dislocated semilunar cartilage of the left knee. She apparently made a normal recovery and was discharged from the hospital two weeks after her operation. The second day she was at home she had a sudden sharp pain in the region of Hunter's canal in the right leg. The extremity became swollen and tender in this area and she felt feverish. She went to bed and called her family physician who sent her back to the hospital where she was found to have a phlebitis of the right femoral vein. This was apparently successfully treated so that after ten days she was able to return home. Three days later she was seized with a sudden, sharp, severe pain in the upper left quadrant of the abdomen, just below the costal margin which was relieved by a hypodermic of morphine. Since then she has had continuous dull, aching pain in this area which becomes more marked when she moves or takes a deep breath. She seemed to improve and was able to be out of bed but on July 27 she again had an attack of severe pain in the upper

left quadrant which was radiated to the region of the left shoulder. This attack was accompanied by fever and chills. While blood cultures did not reveal a blood stream infection Dr. Jamison reported that she had run a varying degree of fever from the time of her phlebitis until her present admission. Dr. Lemmon was asked to see the patient in consultation after which she was admitted. It is only fair to mention that Dr. Jamison had already made a diagnosis of splenic infarct clinically.

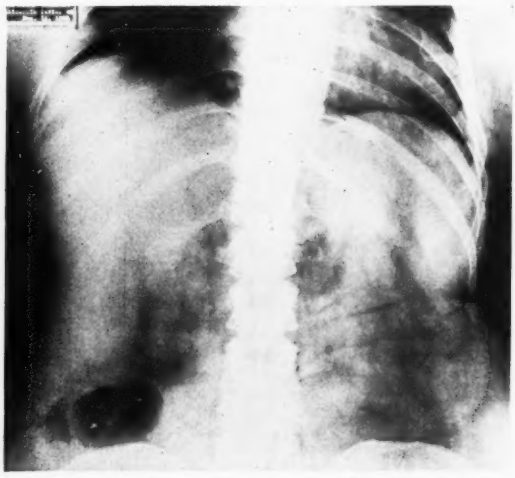

Fig. 3. The above picture of a flat plate taken four and one-half months after operation shows the abdomen to be "essentially negative."

Physical examination revealed the patient to be an obese white female lying in bed in some apparent pain. There was no dyspnea, cyanosis or jaundice. Her temperature was 100.6°F., pulse 98 and respirations were 24. The tongue was coated. Respiratory movements were somewhat restricted, particularly on the left side. Lung expansion was shallow. There were no râles or adventitious sounds in the chest. The abdomen was thick from obesity and somewhat distended in the left hypochondrium. There was marked muscular rigidity and tenderness in this area. No definite mass could be felt. Deep inspiration greatly aggravated her distress. The area of splenic dullness to percussion was increased and caused considerable pain. The area of liver dullness was increased downward but the liver could not be felt due to the thickness of the abdominal wall. Peristalsis was slightly hyperactive. There was thickening along the course of the right femoral vein but no redness or tenderness. The scar of the operation on the left knee was well healed. Hemoglobin was 75 per cent, red blood cells 4,120,000, leukocytes 11,800 with 91 per cent polymorphonuclears. The urine showed a trace of albumin and 10 to 20 pus cells to the lower power field.

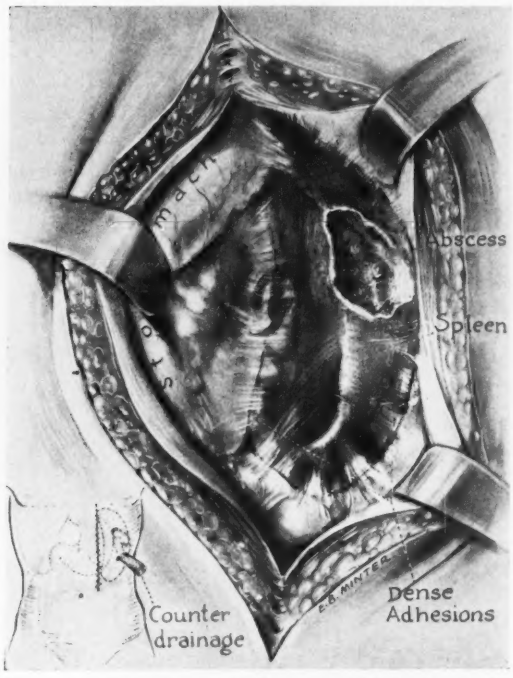

Fig. 4. A diagrammatic drawing which shows the relative location of the abscess, the enlarged spleen displacing the stomach and colon and the newly formed adhesions. The insert shows the site of incision and the point of counter drainage.

Otherwise, the general examination was negative.

On the day after her admission *x*-ray examination of the abdomen with a flat plate and a barium enema were done. Dr. Karl Kornblum reported as follows:

"Abdomen: The flat films of the abdomen show definite enlargement of the right lobe of the liver. The right kidney is clearly outlined. The left kidney is not visualized. In the renal area there is a vague soft tissue mass which appears to be displacing the stomach to the right.

"Barium Enema: Examination of the colon by barium enema shows no evidence of obstruction. The splenic flexure is definitely displaced downward and to the right by a large soft tissue mass in the upper left abdomen. The entire colon filled normally and the contents entered the terminal ileum. One film was made. After evacuation, about twenty per cent of the contents remain distributed throughout the colon. Nothing further noted. Two films were made.

"Interpretation: There is a large soft tissue tumor mass in the left upper quadrant. This is more than likely due to enlargement of the spleen. We cannot absolutely exclude its origin in the left kidney, since we do not visualize this organ. The splenic flexure is somewhat displaced downward and the stomach is being pushed to the right by the mass. There is enlargement of the right lobe of the liver."

The following is a report of kidney study which eliminated suspicion of that organ:

"Retrograde Pyelography: The flat film with catheters in both ureters gives no additional information.

"Retrograde Pyelogram: Retrograde pyelography done on the left side shows the pelvis to be fairly normal in appearance, size and shape. The left kidney is faintly outlined and is normal in position.

"We are inclined to believe that the mass in the left upper quadrant is not primarily in the kidney.

"Interpretation: Negative pyelography on the left side. Tumor mass apparently does not arise in the left kidney."

Her temperature for the first five days in the hospital was below 100°C. but varying between that figure and 97°C., and with a pulse rate between 98 and 72. The muscular rigidity persisted and the tenderness became more marked and localized just below the left costal margin while the pain was progressive and continuous. A diagnosis of splenic abscess was made and operation done on August 5, 1941 under cyclopropane-ether anesthesia with the patient receiving a hypodermic of morphia (gr. ¼) and atropine sulfate (gr. $\frac{1}{150}$) one hour beforehand.

Operation. The abdomen was opened through a left upper rectus incision. The liver was enlarged and the gallbladder was normal. A large mass was present in the upper left quadrant which was adherent to the parietal peritoneum. These adhesions were freed by blunt dissection and the mass was confirmed to be the spleen which was greatly enlarged and adherent to the greater curvature of the stomach and the transverse and splenic portions of the colon. These structures were displaced downward and medially by the splenic enlargement. The omentum was greatly indurated. The anatomical landmarks were obliterated by the extensive induration and newly formed adhesions. The diaphragmatic surface of the spleen was exposed and the field well packed off. The abscess was opened and about a half a cup of pus aspirated. It was thick yellowish and contained pulp-like shreds of splenic tissue. Two iodoform gauze drains were placed in the abscess cavity and over the adjacent surface of the spleen and medially covered with rubber tissue, and then all of these were brought out through a stab-wound in the upper left flank. (The size of the abscess was roughly about 10 cm. long, 7 cm. wide and 3 to 5 cm. deep.) (Fig. 4.) The wound was closed in layers with a rubber tissue drain down to the fascia. A smear of the abscess contents showed Staphylococcus albus.

The first four postoperative days were quite stormy. On the second of these days her temperature was 104.6°F. and pulse 140. Use of the oxygen tent, the Wagensteen suction apparatus, continuous venoclysis and opiates improved her condition. Drainage was profuse. On the third postoperative day her temperature was below 100°F. most of the day but on the fourth day she had a sharp rise of temperature to 108°F. with profuse sweating, cyanosis and rapid shallow respirations. In a short while, however, the temperature dropped to less than 101°F. From this point she gradually improved. Repeated blood cultures were negative. The oxygen tent was removed on the sixth postoperative day and she was then able to tolerate fluids by mouth. The drains were shortened and finally removed on the twelfth postoperative day. Healing of the wound was delayed by an extensive infection of the superficial fat. She continued to run a low-grade temperature and had a considerable quantity of drainage from the wound infection for about thirty days. Finally, this subsided and she improved generally. She was discharged on September 17, 1938, forty-two days after operation.

Dr. C. J. Bucher's pathological report on the operative specimen was as follows:

"Histology: Sections consist of tissue from the spleen. There are a number of hemorrhagic areas. There is considerable necrosis and the entire spleen is infiltrated with polymorphonuclear leukocytes. There is a loss of the architecture, so that from the sections it cannot be recognized as spleen. As much as I can say from the tissue submitted, it is an inflammatory lesion."

On December 12, 1938 re-examination of the patient's abdomen by *x*-ray revealed that it was "essentially negative." (Fig. 3.)

At this time, three years after her illness, she is in good health and active. She has a small incisional hernia at the lower part of her incision which causes her no discomfort. We consider her a case in which splenotomy for splenic abscess was done and recovery followed.

SUMMARY

A study of the literature reveals that splenic abscess is not a condition encountered infrequently. With the use of all facilities for study the diagnosis should not present great difficulty. Splenotomy is most generally employed for surgical treatment of a splenic abscess but splenectomy is desirable in selected cases. We have reported a case of abscess of the spleen in which recovery followed operation.

REFERENCES

1. MALONE, T. L'ascesso della milza (Abscess of the spleen). *La. Settimana med.*, 27; 1133–1150, 1939.
2. GRAND-MOURSEL, P. E. Contribution a l'etude des abces de lat rate. These de Paris, 1885.
3. KUTTNER, H. Uber sequestrierende Milzabscesse. *Bietr. z. klin. Chir.*, vol. t, liv. p. 405, 1907.
4. BILLINGS, ARTHUR E. Abscess of the spleen. *Tr. Am. Surg. Ass.*, 46: 96–108, 1928.
5. WALKER, T. IRVING, JR. Abscess of the spleen. *Tr. New England Surg. Soc.*, 13: 94–104, 1930.
6. INLOW, W. D. Traumatic abscess of the spleen. *Ann. Surg.*, 45: 368–379, 1927.
7. ELIASON, E. L. Case report: splenic abscess. *Ann. Surg.*, 97: 301, 1933.
8. CALDERERA, E. Acute abscess of the spleen. *Surg., Gynec. & Obst.*, 67: 265, 1938.

BY splenectomy, . . . a considerable portion of the blood which burdens the varices is eliminated, and the danger of hemorrhage is diminished. From—"Surgical Physiology"—by Joseph Nash (Charles C. Thomas).

BLOOD WITHIN THE BRONCHI FOLLOWING HEAD INJURIES*

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DESPITE the fact that the early respiratory disturbances and abnormal lung signs that occur in connection with head injuries have been ascribed most often to trauma of the medullary respiratory center, other, equally important, non-neurological factors may play more than a minor rôle in the production of these respiratory signs and symptoms.

Particularly is this so when there is bleeding from the nose, ear or mouth. Consequently, if the entire clinical picture is not fully understood and proper treatment instituted, many patients, who should live, will die.

REPORT OF FATAL CASES

Two of the patients were seen at a time when our conception of the mechanism involved in the production of such deaths was decidedly undeveloped; and, even when the third patient arrived, we still only partially understood the cause of the respiratory symptoms.

CASE I. This patient had sustained a head injury which rendered him unconscious and produced bleeding from the nose and mouth. Although consciousness was partially regained on entry to the hospital where he was placed in the semi-Fowler posture, irritability was pronounced, and, the breathing became increasingly labored, rapid and noisy. The course was continually downhill, and within eighteen hours the patient was dead.

CASE II. This patient had received a type of injury similar to that in Case I, but in addition to the preliminary unconsciousness and irritability with noisy labored breathing, this man was coughing and expectorating bloody, foamy material. On a basis of the latter symptoms an associated chest injury was suspected, but it was neither proved nor disproved clinically. Death occurred twelve hours later.

As I look back now I am very much surprised that in neither of these cases was much thought given as to just why the patients died. The deaths were more or less taken for granted.

CASE III. This patient, who had been knocked from a ship and rendered unconscious, presented a clinical picture so identical with the previous patient that a tentative diagnosis of combined head and chest injury had been made, and the semi-Fowler posture employed. Yet, notwithstanding the shallow, rapid, labored, noisy breathing, the impaired percussion note, and the diffuse bilateral râles and rhonchi, I could find no objective evidence of external chest injury. There was no subcutaneous emphysema, no rib crepitation and no sign of pneumothorax or hemothorax.

Consequently, I was inclined to interpret the chest condition as due solely to a head injury from which blood was dripping down into the lungs,[1,2,3] and, as therapy, recommended change of posture and bronchoscopic removal of the intrabronchial blood.

There was a difference of opinion among the consultants, however, and my idea was not accepted. The neurosurgeon was quite emphatic in his contention that the chest signs were attributable to lung injury and maintained that stuporous head injury patients might swallow blood but would not aspirate it. Objections were also raised to the making of a chest plate for fear that any slight movement would have a deleterious effect. But at any rate, four hours later the patient was dead.

Coroner's Autopsy: There was no air or blood in the pleural cavity, no surface injury of the visceral or parietal pleura, and no break in the bony framework of the thorax. The surface of

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both lungs was of a blood red color, while the lungs themselves were solid and heavy. On cut section, free blood ran out from the bronchi

Fig. 1. Specimen of cat's lungs following experimental head injury. The massive dark areas in each lung indicate the extensive collection of free blood within the air channels. Note the marginal obstructive emphysema at the apices.

and air spaces. The coroner's official opinion on the thorax was: "Lung injury due to chest trauma."

Case Discussion: It seemed to us that the postmortem diagnosis had been arrived at without sufficient substantiating evidence. Was the mere presence of blood in the bronchi and air spaces indicative of lung injury and pulmonary bleeding, or could the blood have come from another source? Could it have drained, as we believed, from the injured head into an intact lung? These questions are of such clinical importance that we sought the answers in the experimental laboratory.

EXPERIMENTAL STUDY

Seven cats were struck on the head with an iron bar to render them unconscious and produce bleeding from the nose and mouth. The details of the experiment are reported elsewhere,[4] but suffice it to say that six of the seven animals showed free blood in varying qualities within the bronchi and lungs even though no chest injury had been sustained. (Fig. 1.)

As a result of these experiments and other observations which shall be discussed later, we can state that blood from head injuries drains down along the posterior nasopharynx, chiefly by gravity, into the larynx and lumen of the tracheobronchial tree. By partially or completely plugging the major or minor bronchi, the collected blood initiates the onset of obstructive pulmonary emphysema, or, as the case may be, obstructive atelectasis.[5] It most often occurs in the unconscious, stuporous and semiconscious, but may be found in others.

The consequent impairment of air flow reduces the vital capacity and increases the respiratory and circulatory rates. The coughing and bloody expectoration represent an attempt on the part of the lung to restore the normal air flow by evacuating the bloody material which drained down from the injured head. But if this evacuation is insufficient, and, if the vital capacity is reduced beyond the safety level and kept there over too long a period, death will ensue.

GENERAL DISCUSSION

We have not had an opportunity of passing the bronchoscope on a head injury patient who showed abnormal lung signs and respiratory distress. How then can we say that the observations on the cat apply equally well to man and that blood will run down from an injured head into the lung? Is not a radical paranasal sinus operation a form of bleeding head injury? And does the blood from the operative site find its way into the lumen of the tracheobronchial tree?

We bronchoscoped two such patients immediately after the completion of sinus operations, and found large quantities of blood within the bronchi of both lungs despite the fact that a nasal-throat plug had been used during the sinus procedure with the aim of preventing aspiration. Both of these patients showed only negligible amounts of filmy blood on the posterior pharyngeal wall, and being classified as "dry cases," it is no wonder that the nasal

surgeon, looking upon the bronchoscopy as an unnecessarily academic procedure, was amazed at the large quantity of blood which was actually present within the tracheobronchial lumen. The blood was removed by bronchoscopic suction and the recoveries were uneventful. Let us re-emphasize that meager amounts of blood in the pharynx of head injury patients is a very poor index of the amount of blood within the tracheobronchial lumen. There is only one way to be positive, that is to look.

CONCLUSIONS

1. In head injuries with bleeding from the nose, mouth, ear or base of the skull, free blood can drain into the tracheobronchial tree and produce bronchial obstruction with abnormal lung signs and symptoms.

2. These abnormal lung signs are sometimes mistakenly interpreted as evidence of medullary trauma, or even as indicative of concomitant chest injury.

3. I believe that many of the bleeding head cases in which the patients die would live if this bloody material were removed, or, better still, prevented from entering the lung by the employment of proper postures and the use of suction.

4. From the standpoint of preventing these serious lung complications, the semi-Fowler position should be discarded for head cases, and instead, the foot of the bed should be elevated and the head of the bed lowered.

REFERENCES

1. Brunn, Harold and Faulkner, William B., Jr. Pulmonary suppuration. *Proc. First Pan-Pacific Surg. Conf.*, 1: 181–182, 1929. Intrabronchial drainage: a discussion of its importance in the diagnosis and treatment of pulmonary suppurations. *Surg., Gynec. & Obst.*, 51: 115–124, 1930.
2. Faulkner, William B., Jr. Internal drainage—a newer conception of the cause of postoperative death of patients with pulmonary abscesses, bronchiectasis, and pulmonary tuberculosis; suggestions as to prevention. *Am. J. Surg.*, 12: 27–31, 1931.
3. Faulkner, William B., Jr. and Faulkner, Edward C. Innendrainage—Ein Faktor beim Zustandekommen des postoperativen massiven Lungenkollapses (Atelektase der Lunge); Vorschläge zur Verhinderung und Behandlung. *Zentralbl. f. Chir.*, 58: 2572–2588, 1931. Internal drainage—A causative factor in the production of postoperative massive collapse of the lung (pulmonary atelectasis). Suggestions as to prevention and treatment. *Acta chir. Scandinav.*, 69: 105–119, 1931–1932.
4. Faulkner, William B., Jr. Severe head injury and its accompanying respiratory difficulty; an experimental study. *Pacific Coast Med.*, 9: 34, 1941.
5. Faulkner, William B., Jr. and Faulkner, Edward C. Postoperative massive collapse of the lung. Its cause, prevention, and treatment. *Northwest Med.*, 32: 87–92, 1933.

CARCINOMA OF THE ILEOCECAL VALVE*

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REPORTS of neoplasms in the ileocecal valve have been presented so infrequently, that tumors in this situation are considered of rare occurrence. For this reason, we believe that the record of our case including a review of the subject is of value.

An appreciation of lesions in the region of the ileocecal junction might best be obtained if the embryology and physiology of this interesting part of the gastrointestinal tract is considered. Keith makes a comparison between the complex structure of the ileocecal junction in the higher mammals with that of the human. In an early embryonic stage, the mammal presents an additional sphincter which separates the cecum from the colon. Later, this sphincter merges with the ileocecal junction. Persistence of this vestige is sometimes found in the human. This may be considered as a development of functional specialization in this region. Furthermore, Keith notes that the relationship between the stomach and ileocecum is dependent upon the feeding habits in which one or the other is either simple or complex in structure. For example, in the horse, the structure of the cecum is complex as compared with the simple nature of the stomach. The reverse holds true in ruminant animals. In the early stages of human embryonic life, the hind gut consists of a straight tube which soon differentiates. The future cecum located in the left side of the abdomen, grows so rapidly that the junction with the ileum forms a right angle. Development proceeds with rotation of the large gut around its long axis toward the right.

The physiology of the ileocecal sphincter consists of a valve-like mechanism which allows for intermittent emptying of the ileal contents into the cecum. Well developed circular muscle fibers in the sphincter alternately contract and relax, depending on the stimulus involved. Fasting slows the expulsion of ileal fluid while the swallowing of food or emotional states increase the frequency. It has been definitely proved that only great pressure will open the ileocecal valve from the cecal side whereas a comparatively lower pressure from the ileum is required for the propulsion of its liquid contents. These phenomena have been directly observed in man by visualization through a cecal fistula. The sphincter presents itself with a central aperture in a small papilla. A marked resistance was encountered when insertion of the finger was attempted through the papillary opening. Under direct vision it was also observed that the flow of fluid from the ileum into the cecum was intermittent and affected by the stimuli previously mentioned. The function of the ileocecal valve is twofold: It serves to hold back the ileal fluid content until digestive and absorptive processes are completed and bars the entrance to the ileum from a return flow from the colon with its detrimental, highly contaminated bacteria.

Consideration of the etiology and incidence of carcinoma in the gastrointestinal tract includes the significance of the common sites of occurrence. These locations are the regions of greatest constriction or the curvatures—cardiac end of the stomach, pylorus, ileocecal region, colic flexures, rectosigmoid and anorectal pouch. On the other hand, neoplasms of the small intestine are rare. According to Sherwood, the etiology of gastrointestinal malignancy is

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the " . . . constant irritation and increased muscular action or spasm at the points of greatest constriction." It is important to note that trauma to the ileocecal valve is much less than that to the pylorus where the trauma resulting from irritating gastric juice and solid food is greater. Perhaps this accounts for the comparatively lower incidence of neoplasms in this region. Adam is of the opinion that chronic irritation with inflammation is most often the causative factor. With these views in mind, we would expect to find carcinoma of the ileocecal valve more prevalent. Ewing lays stress on the anatomical factors in the etiology. Muir states that the most common site for these malignancies is in the upper region of the rectum and next in the order of their frequency are the flexures and the ileocecal region.

Various writers differ greatly in estimating the incidence of ileocecal valve growths. It is apparent that this confusion lies in the statistical method wherein the differentiation of cecal, ascending colon and confined ileocecal valve malignancies are in most instances classified under a collective heading as "ileocecal" tumors. As a result, the recorded incidence varies from 1.1 per cent (Treves quoted by Carnot) to 24.2 per cent (DeBovis). Furthermore, peremptory evidence of the source of the neoplasm is most difficult to ascertain because of the fact that these lesions are nearly always seen at a late stage in the course of the disease. This observation was made by Adam who reviewed 132 "ileocecal" cancers of which only twenty seemed to have had their origin in the ileocecal valve. Some writers (Desmaret, DeBovis et al.) believe that the great majority of cases originate in the ileocecal valve and subsequently spread. Others (Loubart and Cugnier) found the percentage to be low. Their deductions were made from the study of a large number of cases of which only a few were determined with any degree of certainty as having been primary in the ileocecal valve. Wapshaw's statistical review of 455 colon malignancies from the Glasgow Western Infirmary over a ten-year period (1927 to 1937) noted the incidence of 1.32 per cent ileocecal valve carcinomas and 8.35 per cent cecal malignancies. In this series, only sixty were autopsied and one case alone was definitely proved to be a primary ileocecal valve carcinoma. Wapshaw concluded that the ratio of ileocecal valve to cecal malignancy was 1 to 6. It is interesting to note the experiment of Bargen et al. which may explain the limitation of cephalad malignant spread from the cecal side of the sphincter. The submucous injection of India ink solution in the cecum was limited in its dissemination to the papillary edge of the sphincter, whereas the same limitation was observed when the injection was made on the ileal side. This seems to indicate the presence of a lymphatic block or barrier at the summit of the ileocecal papilla.

The pathological development of carcinoma of the ileocecal valve is generally one of three types: (1) Adenocarcinoma—most common; extends rapidly toward the cecal side and has an ulcerative tendency; (2) fibrocarcinoma—stenosing, annular, constricting type; and (3) gelatinous adenocarcinoma—least common; it shows a tendency to extensive ulceration, central slough and large growth.

The concensus of opinion concerning the tendency toward metastasis is that it is greater for growths in the ileocecal region than elsewhere in the colon. This is explained on the basis of a richer vascular and lymphatic supply in the proximal area of the colon. There appears to be a tendency for an associated or secondary intussusception in the presence of ileocecal valve growths. Sherwood reported three cases and Wapshaw one case of this type. Isolated reports of ileocecal tumors other than carcinoma include carcinoid (Christopher) and lymphosarcoma (Sherwood).

The diagnosis of ileocecal valve carcinoma is difficult and usually impossible. The explanation rests with the fact that it is only when the disease is far advanced that symptoms of obstruction become

apparent. Early manifestations are vague and vary from digestive disturbances to recurrent attacks of abdominal pain. Without exception, all cases reviewed by the authors had a common finding in that the diagnosis was determined postoperatively. Adam's case report states that a gastrointestinal series taken a few months before operation was negative for any ileocecal pathological condition.

Methods in treatment, as determined from the literature, are fairly uniform. When the patient's general condition permits, a resection of terminal ileum, cecum and ascending colon, with ileotransverse colon anastamosis is performed. In some cases a two-stage operation is a safer procedure and a palliative ileostomy is performed.

CASE REPORT

M. C., No. 795, a seventy-five-year old male, Italian iceman, was admitted to the medical ward August 26, 1940, with a complaint of lower abdominal pain of three weeks' duration. Vomiting occurred twice since the onset of present illness, and the patient had eaten but little because food aggravated the pain. There had been a long history of constipation. Blood had never been noticed in the stools. Herniorrhaphy had been performed in 1920 and the patient suffered with asthma since 1932.

Physical examination revealed the patient to be an adult male not acutely ill or in evident pain. He was pale and moderately emaciated. Aside from the presence of a few moist crackling râles in both bases, distant heart sounds and a faint systolic mitral murmur, the local condition (abdomen) only was of interest. The abdomen was symmetrical. There was no distention or rigidity, but there was slight rectus spasticity over both lower quadrants. Active peristalsis was present on palpation and intestinal loops were felt. Peristaltic rushes could also be palpated and were associated with pain which moved from left toward the right over the lower portion of the abdomen. The liver, kidneys and spleen were not palpable. Digital examination of the rectum revealed the presence of a large prostate but no masses were present.

The provisional diagnosis following examination was (1) partial intestinal obstruction, (2) internal hernia, (3) diverticulitis and (4) bronchiectasis.

For the following three weeks the temperature remained within normal limits. The pulse ranged between 68 and 100. Abdominal pain persisted, was intermittent and of the same character as on admission. Marked anorexia continued. It was agreed that an obstruction involving the small intestine was present. The *x*-ray gastrointestinal series revealed the following positive findings: "One of the loops of the ileum appears narrow. At 24 hours, barium is distributed from the cecum to the rectum. The transverse colon is low and unevenly filled. The sigmoid is redundant and a number of diverticuli are present. A detailed study of the colon and ileum is suggested."

A few days later, *x*-rays following a barium enema revealed that the barium passed readily from rectum to cecum. There was no definite pathological condition in the colon and no reflux into the terminal ileum. The gastrointestinal series was repeated on September 12, 1940, and the following noted: "Serial studies after ingestion of the barium show. At 3 hours most of the barium is clumped in the region overlying the pelvis. At 4, 5, 6 and 7 hours there is noted marked distention of bowel which is presumably small intestine. The conclusions are, (1) Intestinal obstruction, (2) The location of the small bowel rather low in the pelvis is suggestive of a possible internal hernia located in this region as a causative factor." Films taken twenty-four hours and forty-eight hours after ingestion of barium showed passage of the barium into the large bowel as evidenced by barium in the rectum. However, the small bowel still contained a large amount of barium and showed marked distention. Obstruction was apparently of partial nature. A flat plate of the abdomen taken two days later still showed the presence of barium distributed throughout the large bowel and also evidence of distention of the small intestine.

On September 14, 1940, a Miller-Abbot tube was passed through the nose and its progress followed by fluoroscopy. Four hours later the tip of the tube had passed into the duodenum. The cuff was inflated and the tube connected for Wangensteen suction drainage which functioned satisfactorily. In spite of this, the patient continued to have abdominal pain and the distention increased slightly. A blood transfusion (500 cc.) was given. On the following day,

September 15, 1940, laparotomy was performed through a left lower rectus incision. A distended loop of small intestine was traced

Fig. 1. Adenocarcinoma of ileocecal valve. The ileocecal valve presents on its mucosal surface an irregular firm nodular growth which appears hemorrhagic and infiltrates the wall.

proximally to the ileocecal valve and it was noted that the small bowel was markedly dilated in its entirety. The colon was collapsed. A small tumor mass was found confined to the ileocecal sphincter. It felt very firm in consistency and the valve failed to admit the tip of the small finger. The serosa in this region appeared normal in color and consistency. There was no local evidence of inflammation or metastasis. Peritoneal fluid was present in normal amount and quality. In view of the patient's advanced age and poor general condition it was deemed urgent to complete the operation in the shortest possible time. A Witzel ileostomy about 15 cm. from the ileocecal valve was performed and the tube brought out through a stab wound in the flank. The abdomen was closed in layers. The immediate postoperative condition was excellent. The ileostomy tube functioned satisfactorily as did the Miller-Abbot drainage.

On September 17, 1940, a flat plate of the abdomen showed no evidence of obstruction. There was a moderate degree of distention and the tip of the tube was localized in the intestine in the right lower quadrant. The same day, the temperature suddenly rose to 108°F., pulse 92, and audible tracheal râles with a hacking cough were present. Examination also revealed dullness and diminished breath sounds in the right axilla and back with coarse moist râles throughout the chest. *X*-ray showed a pneumonia of the

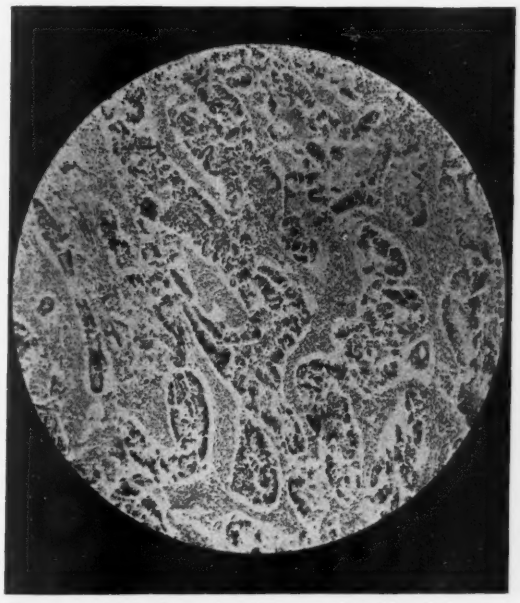

Fig. 2. Abortive glandular acini lined by an immature type of epithelium invading the musculature—adenocarcinoma.

right base. Auricular fibrillation was verified by electrocardiogram tracings. In spite of blood transfusion and other supportive measures, the patient went downhill and expired the following day. The autopsy was limited to the operative incision and abdominal viscera only. The pertinent findings were as follows:

"The ileocecal valve presents on its mucosal surface an irregular firm, nodular growth which appears hemorrhagic and infiltrates the wall. (Fig. 1.) On the inferior surface of the right leaf of the diaphragm there is a hemispherical soft nodule which is friable. The anatomical diagnosis is carcinoma of ileocecal valve, metastasis to the diaphragm and congestion of the liver. The cause of death is (probably) pneumonia." Microscopic section of the growth (Fig. 2) showed an adenocarcinoma.

SUMMARY

A review of the literature on carcinoma of the ileocecal valve is presented. The low incidence of carcinoma at this site is probably due to the inclusion of all growths in this region under one classification in previous statistical surveys. Embryological and physiological factors are considered as

being of possible etiological significance. A case history of primary ileocecal valve carcinoma is recorded.

REFERENCES

1. Adam, Ludwig. *Zentralbl. f. Chir.*, 55: 2187, 1928.
2. Aschoff, L. F. Pathologische Anatomie. Pt. 2. 1936.
3. Carnot, P. *Paris Med.*, 1: 308, 1930.
4. Carnot, P. and Dumont, J. *Paris Med.*, 19: 187, 1913.
5. Christopher, F. *Surg., Gynec. Obst.*, 58: 903–905, 1934.
6. Cabot Case Records. *New England J. Med.*, 208: 1218–1221, 1934.
7. Cugnier, L. These de Paris, October, 1912.
8. DeBovis, R. *Rev. de chir., Paris*, 21: 673, 1900.
9. Desmaret, E. These de Paris. April, 1908.
10. Dukes, C. and Lockhart-Mummery, P. *J. Path. & Bact.*, 29: 308, 1926.
11. Ewing, J. Neoplastic Diseases. Philadelphia, 1928. Saunders.
12. Fraser, J. *Brit. J. Surg.*, 25: 647, 1938.
13. Gaspar, I. *Am. J. Path.*, 6: 515, 1930.
14. Judd, E. S. *South. M. J.*, 17: 75, 1924.
15. Korte, W. *Arch. f. klin. Chir.*, 61–403, 1900.
16. Keith, A. Human Embryology and Morphology. London, 1933. Arnold.
17. Loubart, E. *J. de med. de Bordeaux*, 94: 519, 1922.
18. Muir, R. Textbook of Pathology. London, 1936. Arnold.
19. Mulholland, S. W. *Surg. Clin. North America*, 7: 266–271, 1927.
20. Molesworth, N. W. L. *Brit. J. Surg.*, 21: 370, 1933.
21. Oberndorfer, S. Handbuch der spez. path. anat. u. Hist. Berlin, 1929. Kenke and Lubarsch.
22. Paget, J. *St. Barth. Hosp. Rep.*, 10: 87, 1847.
23. Petermann, J. *Arch. f. klin. Chir.*, 86: 53, 1908.
24. Polak, H. *München. med. Wchnschr.*, 71: 944, 1924.
25. Retford, E. *Surg. Clin. North America*, 3: 689, 1923.
26. Sherwood, W. A. *Surg. Clin. North America*, 7: 1057–1068, 1927.
27. Stewart, M. J. and Taylor, A. L. *J. Path. & Bact.*, 29: 136, 1926.
28. Sperling, L. *Arch. Surg.*, 32: 22, 1936.
29. Wakely, C. P. G. and Rutherford, R. *Brit. J. Surg.*, 20: 91, 1933.
30. Wilkie, D. P. D. *Lancet*, 1: 65, 1934.
31. Wright, S. Applied Physiology. London, 1936. Oxford Univ. Press.
32. Bargen, J. A., Wesson, H. R. and Jackman, R. J. *Surg., Gynec. & Obst.*, 71: 33–38, 1940.
33. Wapshaw, H. *Glasgow M. J.*, 129: 280–290, 1938.
34. Best and Taylor. Physiological Basis of Med. Pract. Baltimore, 1939. Williams & Wilkins.

TRAUMATIC HEMORRHAGIC CHOLECYSTITIS*

WITH HEMATEMESIS AND SHOCK AS THE PRESENTING SYMPTOMS

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ACUTE external trauma to the biliary system giving rise to hematemesis as the essential clinical complaint has been described in the literature only occasionally. Hermanson and Cabitt[1] reported an unusual cause for hematemesis, following trauma to the liver, and call attention to similar infrequent causes. In their case, the mechanism of the hemorrhage, masked at operation by the presence of only an apparent superficial tear, revealed at necropsy a hematoma underneath the healed superficial tear with a direct communication between the portal vein and the larger bile ducts. Hawthorne, Oaks and Neese[2] reported a similar case of liver injury with hematemesis apparently due to a cavity and hematoma deep in the substance of the liver, that continued to necrose and bleed through a large biliary duct until healing finally occurred. Exploratory laparotomy revealed no tears in the bile ducts or liver, so that the above was considered to be the only logical explanation for the continued bleeding through the biliary channels. Thorlakson and Hay[3] report a case of trauma to the liver that was accompanied by melena but not by hematemesis. At necropsy the findings were similar to those of Hermanson and Cabitts'. Other similar cases with melena have been reported, but none of these was accompanied by hematemesis.

In the case herein reported, the source of the hemorrhage was apparently extrahepatic and limited to the gallbladder since cholecystostomy with simple mechanical decompression led to a spontaneous recovery with no recurrence of the hematemesis. The aforementioned cases differ from the case being presented, in that the essential pathological condition giving rise to the hematemesis was in the liver, whereas the essential pathological condition in this case was in the gallbladder, the source being a rupture of a branch of the cystic artery.

Sheddon and Johnston[4] state that the liver is more frequently injured than any other solid organ, yet rupture of the liver is one of the rarest reported surgical emergencies, appearing approximately once in every 1,300 cases brought to an emergency hospital. Traumatic injury of the gallbladder is apparently much less frequent. Monihan[5] found that the right lobe of the liver is injured six times more frequently than the left. Pickworth[6] states that rupture of the liver accompanied by shock is no contraindication to laparotomy, in fact continued shock is prime indication for immediate surgery. Thorlakson and Hay[3] report only three cases of rupture of the liver out of 3,900 accident cases in five years at the Winnipeg General Hospital. In twenty years, out of 200,000 general admissions, only eleven cases of rupture of the liver were noted. Rudberg[7] found only forty-one collected cases of traumatic rupture of the bile ducts in the literature up to 1921. Linormat[8] noted only twenty-four cases of traumatic rupture of the gallbladder itself. Taylor[9] reported an instance of nontraumatic hematemesis of biliary origin arising from a ruptured aneurysm of the hepatic artery communicating with the gallbladder. Considering the paucity of reports of injury to the liver or gallbladder causing hemorrhage into the intestine by way of the common bile duct, it is obvious

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that the condition is uncommon. No reports have been found in the literature in which a traumatic hemorrhagic hydrops of the gallbladder has presented itself with hematemesis and shock, as noted in the case herein reported.

CASE REPORT

A fourteen year old white girl was admitted on March 27, 1940, to the Illinois Research and Educational Hospital with a history of a fall on her right side six weeks prior to admittance. At the time of the fall she was carrying a jar of jelly in her right coat pocket. The injury had been followed by an intermittent pain in the right upper quadrant and right shoulder, accompanied by nausea and vomiting, slight fever, dark stools and tenderness in the right upper quadrant of the abdomen. Just prior to admission the patient had vomited profuse quantities of bright red blood and had become progressively more pale and weak within the period of a few hours.

Physical examination upon entrance revealed a pale, apprehensive, fourteen-year old white girl, apparently acutely ill. The temperature was 100°F., pulse 140, respirations 22, blood pressure 108/60. The essential pathological findings were abdominal and consisted of a tender lemon-sized mass in the right upper quadrant, moderate rigidity of the right rectus muscle, slight distention and normal peristaltic sounds. Rectal examination was negative except for dark red blood on the examining finger.

Laboratory findings revealed a hemoglobin content of 6 Gm; the red blood count was 1,700,000 and the white blood count 12,000. The urine was alkaline in reaction and negative except for an occasional granular cast. The platelets, coagulation and bleeding times were normal. The prothrombin activity was 100 per cent of normal and the ascorbic acid content of the blood was .45 mg. per cent.

The patient was obviously suffering from shock secondary to hemorrhage; in view of the hematemesis, the source of the bleeding was thought to be from the proximal portion of the small intestine, although we were unable to explain the presence of the mass which appeared to be gallbladder. In view of the limitation of the peritoneal findings to the region of the gallbladder, the patient was given a blood transfusion and treated conservatively. A daily blood transfusion for three days brought her red blood count up to 3,090,000 cells, and hemoglobin to 7.5 Gm. Her general condition improved with a pulse of 90 and a blood pressure of 120/72. However, on the third day after entrance, the patient had an acute exacerbation of the local findings with marked muscle spasm and acute tenderness over the right upper quadrant mass, which appeared to be somewhat larger than on admission. This exacerbation, with development of muscle spasm was suggestive of a slowly developing perforation of the intestine; therefore, emergency operation seemed indicated.

At operation the gallbladder was markedly distended and presented into the wound. Exploration of the abdominal cavity revealed no perforation of a viscus or any obvious source of the bleeding. There was a slight induration in the dome of the liver over an area located in the region of the gallbladder. We could not be certain whether or not there might perhaps be a hematoma within the liver, or whether this mass was somewhat artificial, being caused by the distended gallbladder. Aspiration of the gallbladder revealed thick, black, liquid old blood. Palpation revealed an indurated, ecchymotic area alongside the neck of the gallbladder which presumably was the site of rupture of a branch of the cystic artery with the formation of a hematoma in the wall of the gallbladder and escape of blood into its lumen. Blood clots could also be felt in the common duct which was markedly distended but contained no stones. Accordingly, a cholecystostomy was done evacuating the old blood from the gallbladder. A small piece of tissue was removed from the gallbladder for biopsy. The wound was closed around the tube in the usual manner. The postoperative course was uneventful and the patient was discharged on the eleventh postoperative day. The pathological report of the gallbladder wall showed swollen engorged villi but nothing else of significance. The muscularis and serosa were edematous and showed early fibrosis with many new vascular channels. Three months after operation cholecystography revealed no visualization of the gallbladder. The patient has been symptom free since operation one year ago, and at the present time has a normal blood count.

COMMENT

From a consideration of the statistical data in this survey, hematemesis following crushing, nonpenetrating injuries of the

biliary tract probably occurs in less than 2 per cent of that type of injury. The patient herein discussed was a fifteen-year old girl in whom a traumatic nonpenetrating injury to the gallbladder resulted in hemorrhage into the lumen of the gallbladder. The bleeding presented itself clinically as a massive hematemesis with the patient entering the hospital in shock. At emergency operation active bleeding was not observed but the source of the hemorrhage appeared to be a rupture of a branch of the cystic artery, as suggested by the presence of an indurated ecchymotic area alongside the neck of a gallbladder markedly distended with liquid old blood. Although the source of hemorrhage in most instances of bleeding from the biliary tract is usually a laceration of the liver, this possibility is presumably ruled out (on empirical grounds) in the patient herein discussed by the fact that cholecystostomy resulted in cessation of bleeding. No definite preoperative diagnosis was made in this patient. The history of trauma to the right upper quadrant followed by localized peritoneal findings and a mass in that area, combined with hematemesis and shock, led us to the presumptive diagnosis of a crushing wound of the jejunum with intramural and intraluminary hemorrhage. However, the sudden increase in pain, tenderness and muscle spasm in the right upper quadrant was so suggestive of a local peritonitis (which obviously might become diffuse) that we deemed emergency operation strongly indicated. The appearance of early signs of peritonitis suggested that a hematoma in the crushed wall of the intestine had paved the way for a gradual perforation of the intestine with consequent escape of contents into the peritoneal cavity. Since six weeks had elapsed since injury, the development of peritonitis at this time would have to be explained on the basis of the presence of some type of necrotizing process as suggested above, or by rupture of an abscess which might have formed around a small perforation sustained at the time of injury. The fact that the patient had been bleeding for six weeks following injury and has been perfectly well with a normal blood count for over a year postoperatively suggests that the operation contributed to the patient's recovery. The actual mechanism of relief afforded by cholecystostomy cannot be explained except that the favorable influence (if existent) was in some way related to correction of distention of the gallbladder by cholecystostomy. Just why distention of the gallbladder should contribute to recurrent hemorrhage from a laceration in the gallbladder wall cannot be explained unless distention interfered in some way with the return flow of blood from the gallbladder. If this is true, the source of bleeding should be venous, not arterial. This would appear unlikely in view of the fact that small veins of this type tend to thrombose, but blockage of venous return by distention might aggravate the tendency to dislodge clots.

It is evident that bleeding from the biliary tract may present itself clinically as hematemesis or melena by passage of blood through the cystic or common bile ducts. As stated previously, hematemesis arising from the biliary tract usually results from injury to the liver itself, but is nevertheless uncommon. The production of hematemesis by this mechanism is dependent upon certain conditions. For example, it is necessary that the laceration in the liver be sufficiently severe to involve fairly large bile ducts as well as vessels. Moreover, the laceration must not extend through the capsule; if it did, the blood would escape through the torn capsule into the peritoneal cavity. When the capsule is intact and a major bile duct is torn, the blood may then find its way into the open end of the bile duct and subsequently pass into the duodenum by way of the common duct. If the bleeding is massive, blood will regurgitate proximally into the stomach as well as pass distally, thereby resulting in hematemesis as well as melena. As the blood passes the opening of the cystic duct, some of it finds its way through the cystic duct into the gallbladder along with bile. A portion of this blood may clot; clots may lodge in the cystic duct from the gallbladder side and

block the exit. Although the marked distention of the gallbladder in the patient herein reported, was presumably caused by hemorrhage in the gallbladder itself, such distention might be produced in case the injury were limited to the liver itself, if the clot in the neck of the gallbladder would result in a ball valve action. This apparently happens, since distended gallbladders have been observed in lacerations of the liver with melena and hematemesis.

The author wishes to re-emphasize the statement of Hermanson and Cabitt[1] that "it does not seem to be a generally appreciated fact that injury to the biliary tract may give rise to hematemesis and melena." Recognition of this fact would avoid the occasional error made diagnostically in traumatic lesions of the biliary tract. The importance of this statement can be appreciated if we consider how much time might be lost and damage done by the surgeon searching for a torn vessel in the wall of the intestine, when, in reality, the bleeding was arising from a laceration in the liver. Since it is necessary for the capsule of the liver to be intact before blood will escape by way of the common duct into the duodenum in large quantities, the surgeon will find no laceration of the liver, but palpation will reveal abnormal consistency or topography of the liver incident to the laceration and blood clots which will accumulate.

Although it is outside the province of this paper to discuss hepatic injury, the above discussion has been included since injury to the liver alone might result in marked distention of the gallbladder with blood and bile, thereby making identification of the active source of bleeding extremely difficult in some cases. Although there was an area of increased consistency in the liver of the patient herein discussed, we scarcely thought it was definite enough to be classed as a significant injury, particularly because we found a possible source of injury in the gallbladder wall and because elimination of distention of the gallbladder by cholecystostomy apparently cured the patient. We realize, of course, that operation may have had nothing to do with the cessation of bleeding even though it had persisted for six weeks prior to operation.

As far as a perusal of the literature could ascertain, this is the first case in which a nonpenetrating traumatic injury to the gallbladder has produced hematemesis and shock, complicated by a hemorrhagic hydrops of the gallbladder.

SUMMARY

A case of injury to the gallbladder resulting in repeated hemorrhages into the intestine by way of the cystic and common duct, with hematemesis, is described. An indurated, ecchymotic area on the superior wall of the ampulla of the gallbladder, which presumably represented the partially healed site of the hemorrhage was found at operation. An indefinite indurated area in the liver adjacent to the gallbladder was found, but from this data the diagnosis of a laceration of the liver with hemorrhage scarcely seemed justified. The fact that cholecystostomy, with relief of distention in the gallbladder resulted in cessation of the hemorrhage, offers additional evidence that the site of the bleeding was in the gallbladder.

REFERENCES

1. Hermanson, L. and Cabitt, H. L. Hematemesis due to trauma of the liver. *Am. J. Surg.*, 26: 568, 1934.
2. Hawthorne, H. R., Oaks, W. W. and Neese, P. H. Liver injuries with a case report of repeated hemorrhages through the biliary ducts. *Surgery*, 9: 358, 1941.
3. Thorlakson, P. H. T. and Hay, A. W. S. Rupture of the liver. *Canad. M. A. J.*, 20: 593, 1939.
4. Shedden, W. M. and Johnston, F. Traumatic rupture of the liver. *New England J. Med.*, 213: 960, 1935.
5. Monihan, B. Abdominal Operations, 4th ed., p. 237. Philadelphia, 1926. W. B. Saunders & Co.
6. Pickworth, M. E. Traumatic rupture of the liver. *Calif. & West. Med.*, 51: 328, 1939.
7. Mailer, R. Spontaneous rupture of the gallbladder with massive intraperitoneal hemorrhage. *Brit. J. Surg.*, 27: 91, 1939.
8. Rudberg, H. Traumatic rupture of the bile ducts. *München. med. Wchnschr.*, 68: 1650, 1921.
9. Linormat. Traumatic rupture of the gallbladder. Quoted by A. V. Cole. *Am. J. Surg.*, 28: 590. 1935.
10. Taylor, J. H. Massive apoplexy of liver. *Am. J. Surg.*, 24: 373, 1934.

X-RAY DIAGNOSIS OF EARLY INTESTINAL OBSTRUCTION*

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INTESTINAL obstruction, once the nightmare of the surgeon, is now a condition that can be detected by the *x*-ray before irreparable damage has been done.

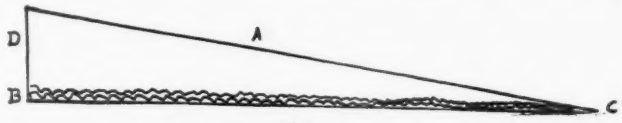

FIG. 1.

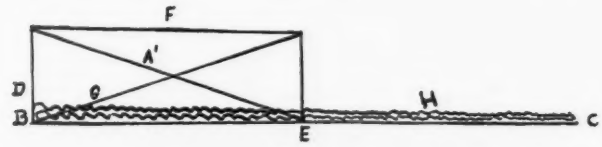

FIG. 2.

FIGS. 1 AND 2. A, normal gradient; B–C, intestinal tract; D, force of peristalsis at the beginning; E, point of obstruction; A′, peristalsis in obstruction more forceful; F, reverse peristalsis with equal force; G, reverse peristalsis with lessened force; H, weak peristalsis beyond obstruction.

The profession is indebted to Schwarz[1] who, in 1911, demonstrated localized gas pockets and fluid levels in coils of the gut and the failure of bismuth to pass beyond a given point. He reported four cases that proved to be intestinal obstruction. The main points in his observations were the gas with fluid level, exaggeration of the Kerkring folds and disturbance of motor function. This work was corroborated by Stierlin[2] in 1913. Kloiber[3] demonstrated that the characteristic *x*-ray findings are sometimes seen as early as three hours after the onset of symptoms.

The marked similarity of paralytic ileus and mechanical obstruction has caused some confusion in making a differential diagnosis. The cause, *x*-ray findings, treatment and prognosis are decidedly different. It is the object of this paper to present the differential aspects as determined by the lateral view of the abdomen with the patient lying on the back and the upright view in the anteriorposterior projection. The air pockets and fluid levels are clearly visualized in mechanical obstruction but the latter are absent in paralytic ileus. This important information cannot be obtained from the anterior posterior view while the patient is in the prone position.

In order to explain these differential points it will be necessary to review some phases of the physiology of the gastrointestinal tract, both normal and pathological. The factors in paralytic and mechanical obstruction are the presence of gas and failure of motor function in both, and the presence of fluid levels in the mechanical type.

The anatomical considerations are important because of the bearing on symptomatology and the time of the appearance of fluid and gas in different portions of the intestinal tract. Dragstedt and his associates[4] have demonstrated a much richer blood supply due to the larger size of the vessels in the upper segments of the intes-

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tinal tract as compared with the lower. The vessels decrease in size as the distal end is approached.

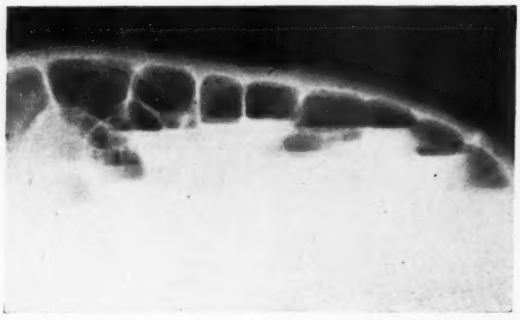

Fig. 3. The lateral projection is made with the patient lying on the stretcher. Note the distention of the abdomen, pockets of gas in the coils of gut and numerous fluid levels. These, of course, could not be seen in the anteroposterior view.

Morton[5] states that the secretion of the duodenum is five to ten times that of the ileum in a given period of time. According to Owings[6] the pressure in the intestinal tract under normal conditions is 2 to 5 cm. of water. This has been known to increase to 24 to 36 cm. of water in twenty-four hours in the duodenum and ileum when obstruction is present. The greater the peristalsis the greater the pressure.

Brandes[7] claims that in mechanical obstruction there is great hypertonicity and less absorptive powers. This is another factor causing increased pressure.

Ochsner[8] in his experiments on animals found that in strangulation of the jejunum, positive *x*-ray evidence occurred in three hours. In simple obstruction of the ileum gas was found in one hour and fluid levels in three hours. In strangulated obstruction of the ileum gas and fluid occurred in one hour.

In summarizing, we have a vicious circle. The higher the obstruction the earlier and more severe the symptoms. The obstruction to the flow of the intestinal contents brings about increased pressure and decrease in the absorptive powers of the gut, increased peristalsis, increased pain and toxicity.

The above condition gives a mark distortion of the gradient. This might be illustrated in Figures 1 and 2.

Fig. 4. The film was made with the patient standing. Note the numerous fluid levels which could not be detected in the anteroposterior view, recumbent position.

CASE REPORTS

Case 1. W. J., a female, age seventy-three, had a pulse rate of 120, respirations 45, and temperature 97°F. on admission. She complained of nausea, vomiting and constipation of seven days' duration. She had vomited twelve times on the morning of admission. Her abdomen was distended and painful. *X*-ray examination in the anterioposterior view, not seen here, showed an enormous amount of gas in the tract. The lateral view showed pockets of gas and numerous fluid levels. (Fig. 3.) This fits the pattern of mechanical obstruction. The patient died without operation. Diagnosis was confirmed at autopsy.

Case 11. P. R., age forty, was admitted with a diagnosis of luetic gastritis. Wassermann and Kahn tests were negative. There were no distention, nausea, or vomiting, but the patient had drawing sensations in the lower right quadrant. The abdomen was tender and slightly distended. The temperature was 98.8°F. pulse 96, respirations 20. *X*-ray examination in the upright position showed gas and fluid levels. (Fig. 4.) Diagnosis: intestinal obstruction. Operation showed postoperative adhesions

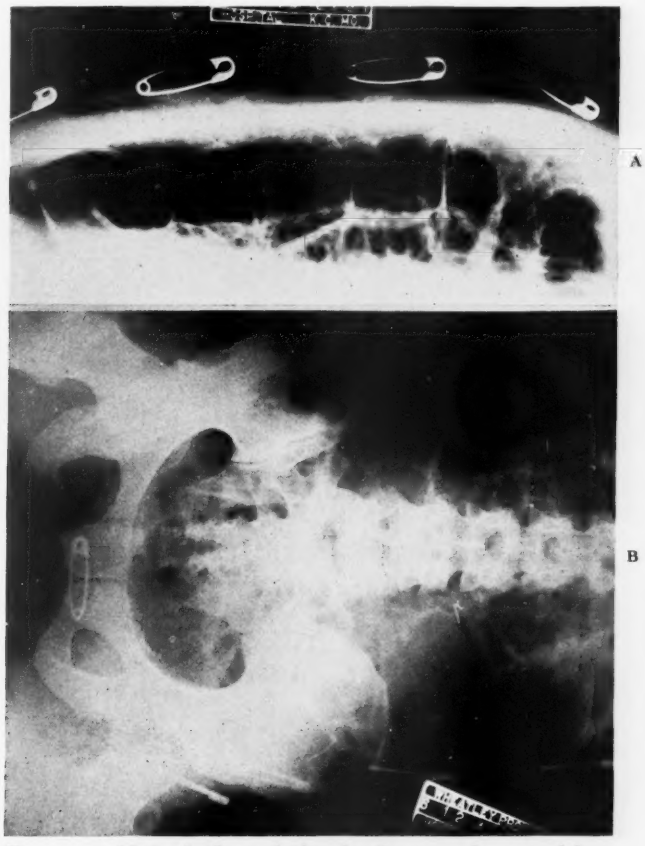

Fig. 5. A, this is the lateral view in the recumbent position. Note the enormous amount of gas in the coils of gut but no fluid levels. This information could not be obtained from the anteroposterior view (B) taken in the prone position.

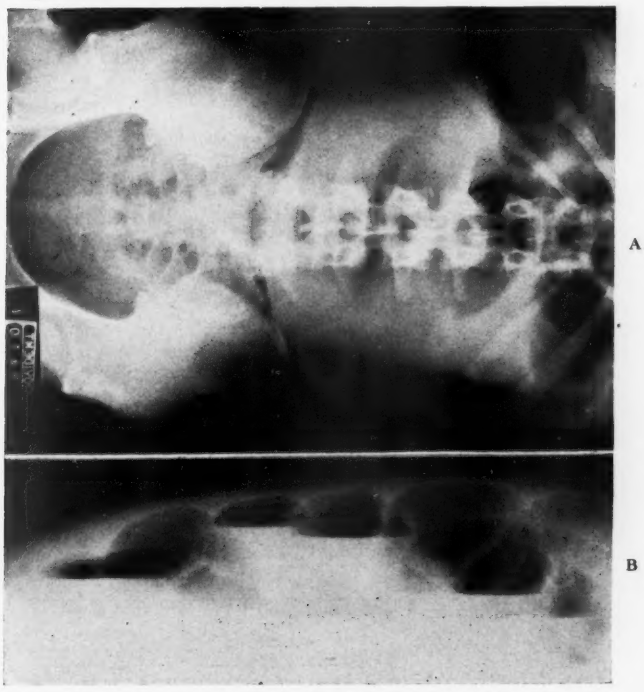

Fig. 6. A, shows an anteroposterior view of the abdomen with the patient in the prone position. B, lateral view with the patient in the prone position.

causing partial obstruction in the hepatic flexure of the colon.

Case III. L. G., a female, age thirty, was

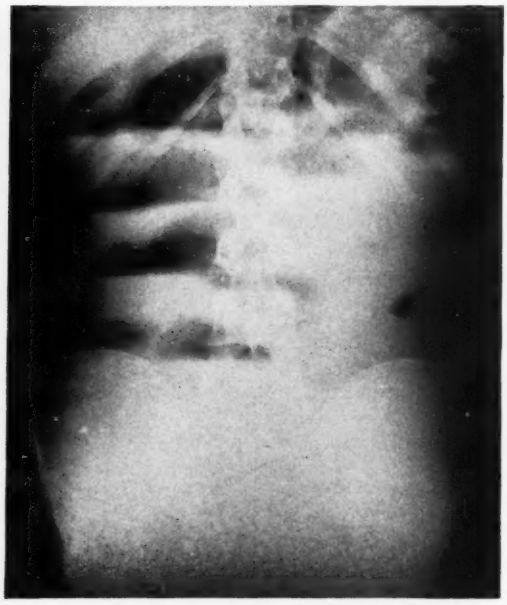

Fig. 6. c, this shows the patient in the upright position.

operated upon June 8, 1940 for appendicitis. On June fifteenth the patient complained of pain in the abdomen and distention was present. *X*-ray examination showed intestines markedly distended with gas but no fluid levels. (Figs. 5A and B.) Diagnosis: paralytic ileus. The patient was operated upon in about two hours after the *x*-ray was made. A purulent peritonitis with recent, very soft adhesions were found.

Case IV. J. C., a male, age nineteen, entered the hospital complaining of sudden pain in the abdomen. He had vomited once, twelve hours after the onset. Figure 6A shows an anteroposterior view of the abdomen with the patient in the prone position. Gas pockets in the dilated gut were prominent. Figure 6B is a lateral view with the patient in the prone position and Figure 6C shows the patient in the upright position. Numerous fluid levels and gas pockets are noted. They were persistent after the administration of enemas. These films were made twenty-four hours after the illness began. Diagnosis of intestinal obstruction was made on these findings.

The operation showed the ileum bound down by a band of adhesions. It was four inches from the cecum and about one inch in width. The obstruction was not complete. The entire gut above was red but not gangrenous. Numerous bands of adhesions were found around the cecum and lower portion of the ascending colon. Recovery was uneventful.

CONCLUSIONS

The necessity of upright and lateral views of the abdomen in making a diagnosis of intestinal obstruction is emphasized. Cases are presented showing the differential points between mechanical obstruction and paralytic ileus based on the presence or absence of gas with or without fluid levels.

REFERENCES

1. Schwartz. Die Erkennung der tiefenen Dunndarmstenosen mittels des Roentgennerfahrens. *Wien. klin. Wchnschr.*, 24: 1386–1390, 1911.
2. Stierlin, E. Zur Roentgendiagnostick der Dunndarmstenose unddes Dunndar nim mileus. *Med. Klin.*, 9: 983–986, 1913.
3. Kloiber, H. Die Roentgendiagnose des Ileus Ohns Konstramitel. *Arch. klin. Chir.*, 112: 513–591, 1919.
4. Dragstedt, C. A., Lang, V. F. and Millet, R. F. *Arch. Surg.*, 2257, 1929.
5. Morton, J. J. and Scabius, S. J. *Arch. Surg.*, 17: 860, 1928.
6. Owings, McIntosh, Stone and Weinbirg. *Arch. Surg.*, 17: 2237, 1928.
7. Seulberger, P., Brandes, K., and Roth, W. Experimentelle Untersuchengen biem hohen Dunndarmierschluss: zur Frage der Resorption beim hohen Dunnadramileus. *Beitr. z. klin. Chir.*, 158: 1–38, 1933.
8. Oschner. *Surg., Gynec. & Obst.*, 52: 702–712, 1931.

ERRORS IN INTERPRETATION OF REFERRED PAIN OF BONE ORIGIN*

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MANY errors in diagnosis result from an almost universal tendency to consider the region of pain localization as the seat of the disease. The patient judges the position of his disease by the most prominent, painful symptoms. The physician, however, should not fall into this trap. Failure to elicit local signs of disease, such as redness, tenderness, swelling or increased heat, immediately should suggest the possibility of referred pain.

The reality of referred pain of pleural and peritoneal origin is attested by numerous case reports and by the investigative work of Morley,[1] Capps,[2] McKenzie[3] and Lenannderer.[4] Kellegren's[5] careful investigations demonstrate conclusively that deep somatic structures such as tendons, bones, muscles and ligaments, give rise to referred pain with a spinal segmental distribution, a fact originally postulated by Hilton[6] following clinical observations.

Hilton (1880) mentioned that "sympathetic" pain in the knee as a result of disease of the hip joint commonly was recognized before his day. He cited pain in the forearm arising from disease of the shoulder joint, and abdominal and thoracic pain associated with disease of the vertebrae. Bruce[7] (1904) wrote at length on the subject "Referred Pains of Gouty Origin" and quoted Hilton freely. He, too, mentioned pain and tingling in the forearms associated with inflammation of the shoulder joint, and pain in the limbs in affection of the articulating surfaces of the vertebrae. Upson and Nielson[8] (1928) presented roentgenograms of the spine and correlated the pathological findings with referred pain and muscular atrophy. Wagner[9] (1935) reported a series of twelve congenital defects of the lumbosacral joints associated with nerve symptoms. Neither Wagner nor Upson and Nielson differentiated between pain arising as a result of bone pressing on a nerve, as in a gibbus or spondylolisthesis, and referred pain of bone origin although some of their cases belonged in the latter classification. Schnaberth[10] (1939) reported a case with indefinite pain in the right hip for years as the only symptom of tuberculous spondylitis of the fourth and fifth vertebrae. He stated that he, like several other consultants, had considered the man a malingerer for several years until the true cause of his pain was discovered by accident, roentgenologically.

FIG. 1. Chondrosarcoma (A) that gave rise to referred pain localized in the arch of the right foot. Lesion was overlooked for two years.

The following case reports further attest the failure of the profession to appreciate

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the reality of referred pain of bone origin. All had been diagnosed incorrectly one or more times. With few exceptions the underlying cause remained undiscovered until definite, localizing, objective findings developed. In several patients needless operations were performed in the region of pain localization.

FIG. 2. Round cell sarcoma (A) of the left sacro-iliac joint overlooked for eighteen months. It had given rise to referred pain localized in the left ankle.

CASE REPORTS

CASE I. E. K., a white female, thirty-nine years old, suffered for two years with constant, severe pain in the arch of her right foot. Despite repeated examinations and treatment, no cause for the pain was demonstrated and no relief experienced. Gradually the pain spread up her leg. Attention was drawn to the hip only after the thigh had become swollen. Roentgenograms of the ankle revealed no disease; those of the hip showed a destructive lesion involving the intertrochanteric region of the femur. (Fig. 1.) An operation was performed and a blue-gray cartilaginous tumor removed. Following operation the pain disappeared. The histological report was of chondrosarcoma. Within the year the tumor recurred, as did the pain, and the patient died with metastasis.

CASE II. F. R., a white female, age twenty-four years, for eighteen months had constant ankle pain with occasional exacerbations, during which the pain spread to the calf and thigh. Roentgenograms of the ankle and knee showed no pathological state. Repeated examinations by various physicians failed to reveal a cause for pain. The pain finally spread over the entire leg. Roentgenograms of the pelvis showed a destructive lesion involving the left sacroiliac joint. (Fig. 2.) A biopsy was performed and examination of the removed tissue revealed it to be a round cell sarcoma. Irradiation of this tumor resulted in temporary relief from pain. The tumor recurred, as did the pain, and the patient died with metastasis.

CASE III. R. J., a white female, twenty-one years old, complained of pain in her right knee of eleven months' duration. The pain appeared shortly after an automobile accident, which was thought by the patient to be the cause of the onset of symptoms. There were never any local findings such as swelling, redness or tenderness. The pain was well localized to the skin overlying the region of the internal semilunar cartilage. Roentgenograms were taken. Orthopedic consultants considered the symptoms to be the result of a torn internal semilunar cartilage, as that was where the pain localized. An operation was performed and the internal cartilage removed, but the patient experienced no relief. A third surgeon advised removal of the lesion on the shaft of the femur. (Fig. 3.) Microscopic sections showed it to be a chronic, fibrous osteomyelitis. Complete relief from pain followed the operation.

Case IV. J. D., a white male, sixteen years old, first noticed pain in his right knee. The pain appeared without apparent cause and gradually increased until it was present day and night and was severe enough to keep him awake. Although roentgenograms of the knee were negative, the leg was placed in a cast for three weeks. The pain persisted. The patient was referred, therefore, to an orthopedic surgeon who found nothing wrong with knee or hip joint and advised rest. One month later, because of continued pain, the patient consulted a second orthopedic surgeon who also found no pathologic condition. A third consultant found the knee and hip joints normal but on deep palpation of the thigh detected an enlargment of the shaft of the femur. Roentgenograms of this region revealed an osteoid osteoma. (Fig. 4.) Removal of the lesion gave complete relief.

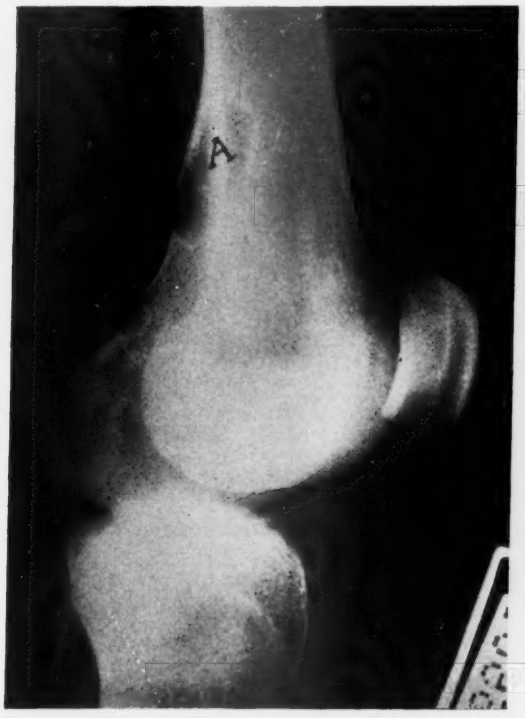

Fig. 3. Chronic fibrous osteomyelitis (A) that caused referred pain in the region of the internal semilunar cartilage. The cartilage was removed without relief of symptoms.

Case V. R. O., a white male, forty-one years old, complained of pain in the right knee of three months' duration. The pain increased in severity and kept him awake at night. Two physicians found nothing wrong with the knee clinically or roentgenologically. At their suggestion three teeth and his tonsils were removed, without relief. A third consultant found no disease in the knee or hip joints, but found the thigh enlarged, warm and tender. Roentgenograms of the femur revealed an osteomyelitis.

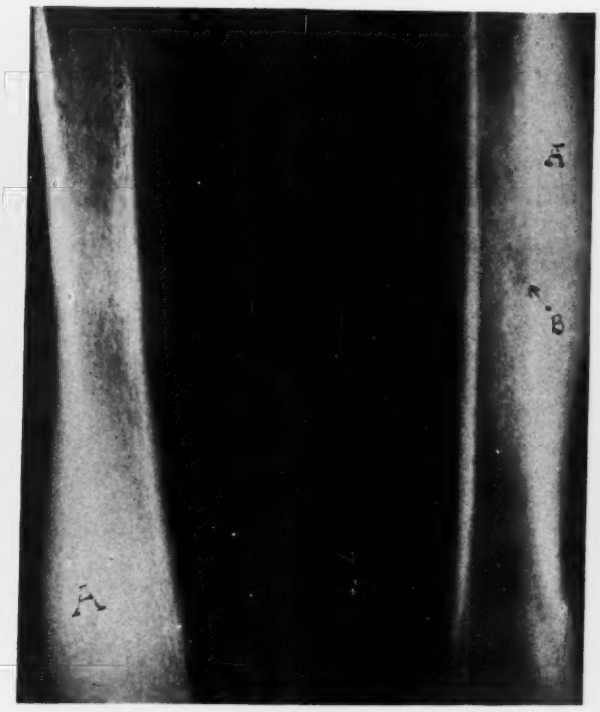

Fig. 4. Osteoid osteoma (B) and periosteal reaction (A) in the middle of the femoral shaft that caused referred pain in the region of the knee joint and upper tibia.

(Fig. 5.) Incision and drainage were followed by complete relief from pain.

Case VI. P. B., a white female, age seven years, complained of pain in the lateral side of her thigh near the knee. Clinically, she presented the typical picture of an acute osteomyelitis of the femur and her pediatrician referred her to a surgeon, who found no disease in the femur. However, he did find tenderness in the ilium in the region of the acetabulum. The pediatrician, positive the femur was involved because the pain was limited to the thigh, insisted that the consultant surgeon first aspirate the tender region. Pus was obtained and an operation was performed revealing an acute osteomyelitis of the acetabulum. (Fig. 6.) Drainage of this lesion was followed by relief of pain in the thigh.

Case VII. N. K., a white female, ten years old, after a fall, complained of pain in the mesial, distal portion of her left thigh. Associated with this was a temperature of 103°F., chills and a leucocytosis of 20,000. Roentgenograms of the femur were negative. A pediatrician diagnosed osteomyelitis of the femur and advised hospitalization. A consultant surgeon

concurred in the diagnosis, and advised incision and drainage of the shaft of the femur. A second surgeon was consulted. He elicited no tenderness in the femur but found tenderness upon rectal examination and noticed slight swelling of the vulva of the same side. Roentgenograms of the pelvis showed no changes. He suggested that operation be delayed. Roentgenograms of the pelvis fourteen days later revealed an osteomyelitis of the interior ramus of the left pubis. (Fig. 7.) Relief from pain followed incision and drainage of the pubic lesion.

Fig. 5. Postoperative anteroposterior and lateral views of sclerosing type of osteomyelitis of the shaft that gave rise to referred pain in the knee joint. A, periosteal reaction; B, operative defect.

Case viii. R. C., a white male, ten years of age, who previously had been operated upon because of recurrent osteomyelitis, complained of pain in the epitrochlear region of the left humerus. There was an associated low grade fever and leucocytosis. Local findings were not significant and roentgenograms of the elbow were negative. Because motion of the elbow increased the pain, the elbow joint was opened but no pus was found. The operation did not relieve the pain and the temperature remained elevated. The patient was discharged from the hospital five days after drainage of the elbow joint. The pain increased gradually and spread up the arm as far as the deltoid region; three days later he was hospitalized. Examination of the deltoid region revealed increased heat, tenderness and swelling of the upper shaft of the humerus. Roentgenograms showed a frank osteomyelitis. Incision and drainage of a large quantity of pus from this region was followed by complete relief of pain and a return of the temperature to normal.

Case ix. H. N., a white male, ten years old, stumbled and fell on his right arm. As he immediately complained of pain in his right elbow, his mother took him to an orthopedic surgeon

Fig. 6. Location of the focus of osteomyelitis (A) that gave rise to referred pain in the lateral portion of the thigh. This is a picture taken five years after onset and shows much more involvement than was originally present.

Examination revealed some slight tenderness in the elbow, no swelling and a full range of motion in the elbow and shoulder joints.

Fig. 7. Osteomyelitis of the inferior ramus of the left pubic bone that caused referred pain in the distal portion of the left thigh.

Fig. 8. Focus of osteomyelitis (A) of the upper humerus that caused referred pain in the elbow for which an arthrotomy of the elbow had been performed.

Fig. 9. Comminuted fracture of the upper humerus that gave rise to referred pain in the elbow region.

Roentgenograms of the elbow joint were negative and the patient was sent home with the arm in a sling. Four days later he returned. Immobilization had given no relief; instead, the pain had grown worse and had spread up his arm. Roentgenograms of the entire humerus (Fig. 9) revealed an impacted fracture of the neck. Immobilization in a Valpeau bandage with plaster to stabilize it gave complete relief from pain.

Cutaneous pains are projected under normal conditions with great accuracy to the joint stimulated. Pains arising in deep somatic structures and viscera, on the contrary, are indefinitely localized and often may be referred to points on the skin remote from the origin of stimulation. The cases reported in this paper as well as the more generally known examples of stones in the cystic duct or ureter giving rise to pain in the region of the scapula and scrotum, respectively; disease of the hip joint causing pain in the knee; pain arising in the dome of the diaphragm, referred to the shoulder and neck, illustrate how faulty the location of disease by pain may be. The clinical and investigative evidence that slowly is accumulating substantiates the opinion that the different visceral and deep-lying somatic structures have a definite, spinal, segmental relation to the skin. Appreciation of this fact, particularly when pain localized to a region in which there are no objective findings is concerned, will eliminate errors in diagnosis. Emphasis should be on the fact that roentgenographic examination should not be limited to the region of pain localization, but should include areas that might give rise to referred pain to this region.

SUMMARY

1. Nine cases of referred pain of bone origin are reported.

2. All had been diagnosed incorrectly one or more times because the region of pain localization had been considered the seat of the disease.

3. Two patients had been operated upon unnecessarily in the region of pain localization.

CONCLUSION

Disease of bone may give rise to referred pain in regions so far removed from the diseased area that roentgenograms limited to the area of pain localization fail to demonstrate the lesion.

Referred pain is undoubtedly more common than is generally appreciated. In the absence of objective findings in the region of pain localization, a thorough search of all deeper somatic and visceral structures that might cause referred pain of the segmental pattern under question will eliminate many mistakes.

REFERENCES

1. Morley, John. Abdominal Pain. New York, 1931. Wood & Company.
2. Capps, Josepha and Coleman, George H. An Experimental and Clinical Study of Pain in the Pleura, Pericardum. New York, 1932. The MacMillan Company.
3. McKenzie, J. The meaning and mechanism of visceral pain. *Brit. M. J.*, 1: 1449, 1906.
4. Lennander, K. C. Beobachtungen über die Sensibilitat in der Bauchhohle. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 10:38, 1902.
5. Kellegren, J. H. Distribution of pain arising from deep somatic structures with charts of segmental pain areas. *Blin. Sc.*, 4: 35, 1939.
6. Hilton, John. Rest and Pain. 3d ed. London, 1880. George Bell & Sons.
7. Bruce, W. Referred pains mostly of gouty origin. *Scot. M. & S. J.*, 14: 297, 1904.
8. Upson, W. O. and Nielson, J. M. Referred pain and muscular atrophy traced to abnormalities of the spine. *Am. J. Surg.*, 4: 616, 1928.
9. Wagner, L. C. Congenital defects of lumbosacral joints with associated nerve symptoms. Study of 12 different types with operative repair. *Am. J. Surg.*, 27: 311, 1935.
10. Schnaberth, K. Indefinite pains in right hip for years only symptom of tuberculous spondylitis of 4th and 5th lumbar vertebras. *Arch. f. Ortbop. u. unfall. Chir.*, 40: 114, 1939.

THE VALUE OF THE FRACTIONAL HORMONAL TESTS IN THE DIAGNOSIS OF HYDATIDIFORM MOLES*

REPORT OF TWO CASES

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INTRODUCTION

HYDATIDIFORM mole is not a rare disease of the placenta. The authors wish to bring before general surgeons the records of two patients who were recently admitted to a 100-bed rural hospital and to emphasize the value of the fractional hormonal tests as an aid in the diagnosis of this disease.

Probably the greatest modern advance in the study of hydatidiform mole was the development in 1929 of the fractional Aschheim-Zondek test[1,2] and the discovery[1] that the excretion of gonadotrophic hormone in the urine of cases of mole was two to three times as great as is found in the urine of normally pregnant women. This sensitive response with small amounts of urine was at first thought to be pathognomonic of a mole, but positive tests in relatively high dilutions were later noted in the presence of toxemias of pregnancy. Mathiew[3,4] believes that the drop in the general mortality in this disease from 12 per cent to 2 per cent in the past ten years may be attributed largely to the use of hormonal diagnostic aids.

The authors believe that the fractional hormonal test probably is more helpful in the preoperative diagnosis of a mole than the usual clinical findings. The smallest amount of urine which gave a positive *Friedman test* in cases of hydatidiform mole was reported by Shoeneck[7] to be .0065 cc. Toxemias of pregnancy have given positive Friedman tests in as small as .001 cc. of urine. The urine of normally pregnant women rarely gives a positive response in a greater fraction than .05 cc.[7] of the specimen.

The *Aschheim-Zondek test* requires the injection of 2.4 cc. of undiluted urine for the usual pregnancy-test. The urine of normally pregnant women has given a positive response in amounts as small as 2.4 cc. of a $\frac{1}{50}$ solution in distilled water. Dilutions from $\frac{1}{50}$ to $\frac{1}{150}$ suggest the presence of a mole, and dilutions above this level indicate the presence of a chorio-epithelioma.[8]

For many reasons the Friedman modification[5] of the Aschheim-Zondek test has been more widely used in America: (1) A definite result can be obtained in forty-eight hours; (2) the rabbit may be used repeatedly; (3) it has not been found practical to keep colonies of mice of six to eight weeks of age. In both tests, however, the results depend upon the presence in the urine of an increased amount of anterior pituitary-like hormone, and the significance of positive tests in higher dilutions with either method is identical.

Hydatidiform moles are estimated to occur once in two thousand deliveries. Recently Mathieu[3,4] stated that they were probably more frequent than this and quoted a figure of one in six hundred private deliveries. The two cases presented in this paper, together with one earlier case found in the files of the hospital, represent an incidence of approximately one in four hundred deliveries.

CASE REPORTS

CASE 1. Mrs. A. D., a twenty year old married American housewife, para 0, gravida 1, was admitted to the surgical service January 28, 1940 with a chief complaint of vaginal bleeding of five weeks' duration.

Her father had suffered from diabetes and Bright's disease; otherwise her past history and family history were irrelevant.

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The patient had had her last normal menstrual period during the third week of October, 1939. About November 1 she experienced some morning nausea and persistent vomiting, which continued until her entrance and was the most probable cause for her twenty-five-pound weight loss. There were no headaches or urinary symptoms during this period.

On December 23 (approximately five weeks before admission) she noticed the onset of dark brown vaginal discharge which required the use of two or three perineal pads daily. Anorexia, nausea, vomiting and marked fatigue, together with frequency of urination were daily symptoms.

On admission her temperature was 99.4°F. by rectum, the pulse rate was 94 per minute, her respirations 18, and the blood pressure 150/90. She appeared to be a pale, thin, undernourished girl. Her fundi were normal. The heart was of normal size and presented no murmurs. Her breasts were full but there was little areolar pigmentation. In the midline of the abdomen a soft, compressible, symmetrical tumor arose from the pelvis and extended to just below the umbilicus. A loud souffle could be heard over the entire lower portion of the mass by auscultation. There was some deep tenderness in the right lower quadrant by palpation, but otherwise the abdominal examination was negative. Her cervix was found to be soft, smooth, and cyanotic and her uterus was soft and almost filled the pelvis. The reflexes were physiological.

Laboratory and Roentgenological Examinations. Biological Pregnancy Tests: The Friedman test was positive with 20 cc., with .025 cc. and with .001 cc., of urine on January 29, 1940, January 29, 1940, and February 1, 1940, respectively.

The hemoglobin was 66 per cent, the red blood cells were 3,250,000 and the white blood cells 8,600 with 70 per cent polymorphonuclears. The icteric index was 10 and the nonprotein nitrogen was 62 mg. per cent. The serum proteins were 4.11 mg. per cent with 2.33 mg. per cent albumin and 1.78 mg. per cent globulin. The albumin-globulin ratio was 1:1:31.

Upon examination of the urine (catheterized specimen) the reaction was acid and the specific gravity 1.022. There was no sugar in the specimen but the albumin test was strongly positive (4 plus). There were occasional red cells in the smear but no casts. The culture yielded a few colonies of Staphylococcus aureus.

The vaginal cultures were not impressive. Only a Gram-negative bacillus grew out on the plate cultured in the anaerobic jar.

Clinical Course. The vaginal bleeding and vomiting ceased after four days of bed-rest. Her general condition continued to improve. The presence of positive Friedman tests in high dilutions of urine made the diagnosis of hydatidiform mole a strong possibility.

On February 14, 1940 the patient was taken to the operating room and under gas, oxygen and ether anesthesia a dilatation of her cervix was performed. A finger was then introduced into the uterus and immediately contacted a soft, jelly-like mass, small amounts of which were removed with sponge forceps. Grossly, the specimens (connected) resembled particles of tapioca connected by a thin greyish-white network of fibers. Subsequent profuse bleeding forced the operator to pack the uterus.

On the second postoperative day the packing was removed. Cultures of the vagina at this time were negative both aerobically and anaerobically. On the third postoperative day she expelled a large mass of tissue weighing over 500 Gm. and thereafter continued to pass small amounts of the mole for the next five days.

On the ninth postoperative day the uterus was completely emptied by curettage under spinal anesthesia. A large amount of necrotic decidual-like tissue was obtained.

Three weeks after her discharge a Friedman test was negative with 20 cc. of urine. The patient was enjoying excellent health and was having what appeared to be a normal menstrual period.

Pathology Report—First Curettage. "Four sections of the tissue were examined microscopically. In these sections blood clots, fibrous tissue, strands of decidua, and typical chorionic villi were found. The latter were most interesting and are surrounded by a loose connective tissue stroma resembling Wharton's jelly. The periphery of the villi are lined by 1 to 4 layers of Langhans cells and an increased number of syncytial cells. In many areas they form small buds in the outer lining of the villi. A few appear normal. Some villi appear edematous while a few others appear to have undergone mucoid degeneration. Necrosis of decidual and villous tissue is present. One section contains a

small area of the inflammatory exudate. In section #4641 the proliferation of the lining cells of the villi is more prominent."

Second Curettage. "The sections of curettings #1 reveal a heterogeneous mass of tissue in which are found uterine mucosa, myometrium, degenerating decidua, organized blood clot, inflammatory exudate, a few Langhans cells and a few syncytial cells. No villi were present."

DISCUSSION

On history and physical examination the patient exhibited many of the typical signs of the disease. The onset occurred during the first trimester of pregnancy and was characterized by vaginal bleeding. Ninety per cent of the patients in various series entered with vaginal bleeding as a presenting symptom. Associated toxemias are reported as complications of pregnancy in 29 to 35 per cent of these cases.[6] This patient's breasts oddly enough lacked the usual development associated with the pregnant state. Although she had missed only three menstrual periods, her uterus was consistent with the size of a five-months pregnancy. Mathieu[3] states that only 50 per cent of hydatidiform moles manifest an abnormal enlargement of the uterus. The positive ovarian response in the rabbit (Friedman) test with dilutions of urine as high as .025 cc. and .001 cc. was largely responsible for the correct preoperative diagnosis.

Case II. Miss D. S., a twenty-six year old single, American white girl, was admitted to the surgical service on May 18, 1941 with a complaint of bloody vaginal discharge of two and a half months' duration.

Her father had had diabetes, but otherwise the past and family history were negative.

On February 27, about two and a half months before, she began to have a bloody vaginal discharge. Menstruation had been regular until her last period, which occurred on January 15, 1941. She spotted slightly on February 27 and since that time had had "slight spotting" daily. She had had some slight nausea and vomiting during the first month, but otherwise had felt fairly well; no fetal movements were noted. She had not lost any weight and had had on headache or excessive fatigue.

On admission her temperature was 98.4°F., her pulse 78, respirations 18, and blood pressure 160/86. She was slightly pale and thin, her eye grounds were normal, and her throat slightly injected. The heart seemed of normal size without significant murmurs. The lungs were clear. The breasts were small with the left nipple flat and the right one inverted. On abdominal examination there was a rather firm symmetrical mass rising out of the pelvis to within one finger-breadth of the umbilicus. It was nontender and there were no other masses felt. On pelvic examination the outlet was marital, and the cervix was soft, smooth and large. There was a small amount of blood in the posterior vaginal fornix. The previously described abdominal mass was apparently uterus.

Laboratory Examinations. Biological Pregnancy Tests: Aschheim-Zondek test (a) 2.4 cc. without dilution was positive; (b) 2.4 cc. with $\frac{1}{50}$ dilution was positive; (c) 2.4 cc. with $\frac{1}{100}$ dilution was positive; (d) 2.4 cc. with $\frac{1}{150}$ dilution was positive; (e) 2.4 cc. with $\frac{1}{200}$ dilution was positive. Friedman test was negative with dilutions of .025 cc., .005 cc., and .001 cc. of urine.

The hemoglobin was 71 per cent. The red blood cell count was 4,350,000 and the leucocytic count 11,600, with 62 per cent polymorphonuclears.

The cell volume was 43.2 per cent and the sedimentation rate .50 mg. per hour. The nonprotein nitrogen values were reported as 18 mg. per cent, the urine acid as 3.9 mg. per cent. The serum protein amounted to 6.23 mg. per cent with the serum albumin accounting for 3.01 mg. per cent. The phenolsulfonphthalein test showed values of 60 per cent for the first hour and 8 per cent for the second hour.

The specific gravity of urine was 1.010 and the reaction acid. There was no albumin or sugar found in the specimen. On microscopic examination three to four red blood cells and a few white blood cells per high powered field were detected. The culture yielded no growth in forty-eight hours.

Clinical Course. The patient was discharged from the hospital after a short work-up because at the time of her discharge we were not certain that she had a mole, for the fractional Aschheim-Zondek test had not been returned. When this was positive in high dilutions, we strongly

suspected the presence of a mole. She was, therefore, readmitted to the hospital on June 2, 1941 and after donors had been procured was operated upon the next morning.

At this time a typical hydatidiform mole was removed from her uterus with average difficulty, and with considerable bleeding. She required a transfusion after the procedure was completed, but otherwise went on to a very satisfactory immediate convalescence. Her blood pressure returned to normal limits (systolic 125, diastolic 75) and her hemoglobin was 88 per cent on discharge. Her slides were reviewed by Dr. A. T. Hertig of the Lying-In Hospital, Boston, who thought the mole tissue had malignant tendencies but that she should be followed conservatively for a period of a few months.

DISCUSSION

This case history is not as yet complete. It is presented, however, to indicate the value of the fractional hormonal tests in the *diagnosis* of this uncommon tumor. For academic reasons both the Friedman and Aschheim-Zondek tests were employed. The Friedman tests were done with very high dilutions of urine in order to determine as accurately as possible the exact concentration of gonadotrophic hormone present. Unfortunately, the dilutions used did not produce any ovarian response in the rabbits. The dilutions employed in the Aschheim-Zondek tests were between two and three times greater than the smallest amounts which could be expected to produce a response in the normal pregnant state. Dilutions of $\frac{1}{50}$, $\frac{1}{100}$, $\frac{1}{150}$ and $\frac{1}{200}$ were strongly positive and indicated the correct diagnosis of mole.[8]

SUMMARY

Two cases of hydatidiform mole admitted to a rural (100-bed) hospital within two years are reported.

In both cases fractional hormonal tests were found to be positive in high dilutions and led to the correct preoperative diagnosis.

REFERENCES

1. Zondek, Bernhard. *Endokrinologie*, 5: 429–430, 1929.
2. Aschheim, Selmar. *Zentralbl. f. Gynäk.*, 52: 602, 1928.
3. Mathieu, A. *Internat. Abstr. Surg.*, 68: 52, 1939.
4. Mathieu, A. *Surg., Gynec. & Obst.*, 68: 844, 1939.
5. Friedman, M. H. and Lapham, M. E. *Am. J. Obst. & Gynec.*, 21: 405–410, 1931.
6. Sherman, J. T. *Am. J. Surg.*, 27: 237–244, 1935.
7. Schoeneck, F. J. *Am. J. Obst. & Gynec.*, 39: 485–488, 1940.
8. Stander. Williams Obstetrics. 8th ed., p. 252, (1941).

LARGE PEDUNCULATED CAVERNOUS HEMANGIOMA OF THE LIVER

CASE REPORT

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WHILE cavernous angiomas are reported to be the commonest benign tumor of the liver they are usually multiple, of small size and fail to produce symptoms.[7] They are usually found at postmortem examinations.[8] The larger tumors become evident when they can be palpated or produce pressure symptoms. Because of their location and their rarity they have been erroneously diagnosed carcinoma of the stomach,[7] metastatic lesion of the liver,[4] pancreatic cyst[5] and pedunculated myoma of the uterus.[2] The incidence of large pedunculated hemangioma of the liver seems sufficiently rare[4,6] to warrant the following report:

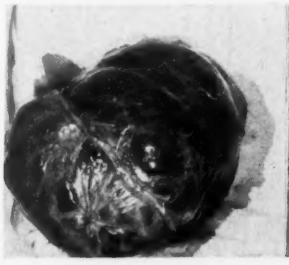

FIG. 1. Photograph of intact gross specimen.

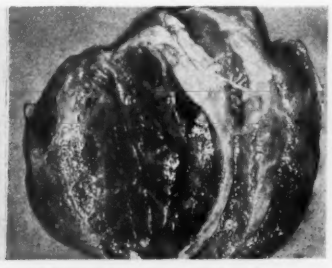

FIG. 2. Photograph of sectioned gross specimen.

CASE REPORT

Miss L. J., age sixty years, a retired school teacher, presented herself in April, 1940, because of an epigastric mass which she had first noticed about six weeks previously. The mass was thought to have grown quite rapidly during this period. The only other symptoms were a throbbing sensation intermittently in the epigastrium, especially when lying down and a soreness in this area when stooping or when turning in bed.

The family history was essentially negative. Her past history revealed an aphonia which developed eight years previously, necessitating retirement from teaching, but was never definitely diagnosed and showed no improvement until a few months prior to this admission.

The patient appeared about stated age without apparent evidence of ill health. Her temperature was normal, pulse 92 and blood pressure 148/90. General physical examination was negative except for the positive findings in the upper portion of the abdomen. Here a large mass was felt which extended about five fingers' breadth below the tip of the ensiform in the midline and its lower margin extended almost the width of the abdomen. It was slightly movable, moved with respirations and seemed moderately tender. The pulsations of the aorta could be felt and a bruit could be heard but the tumor did not seem to have expansile pulsations. The liver margins were within normal limit and the lower margin did not seem to be contiguous with the mass. The spleen was not palpable.

Urinalysis revealed a trace of albumin and no other abnormal findings. White blood count was 8,100 with a normal differential count. The red blood count was 4,630,000 and the hemoglobin was 8.6 Gm. per cent. The sedimentation rate was 8 mm. in one hour and the Wassermann reaction of the blood was negative.

Fluroscopic and radiographic *x*-ray examination of the stomach showed an extrinsic mass

along the lesser curvature which pushed the stomach downward and to the left. Intravenous urography showed a normal urinary tract except for a congenital anomaly on the right side consisting of a bipid type of kidney pelvis and incomplete duplication of the right ureter.

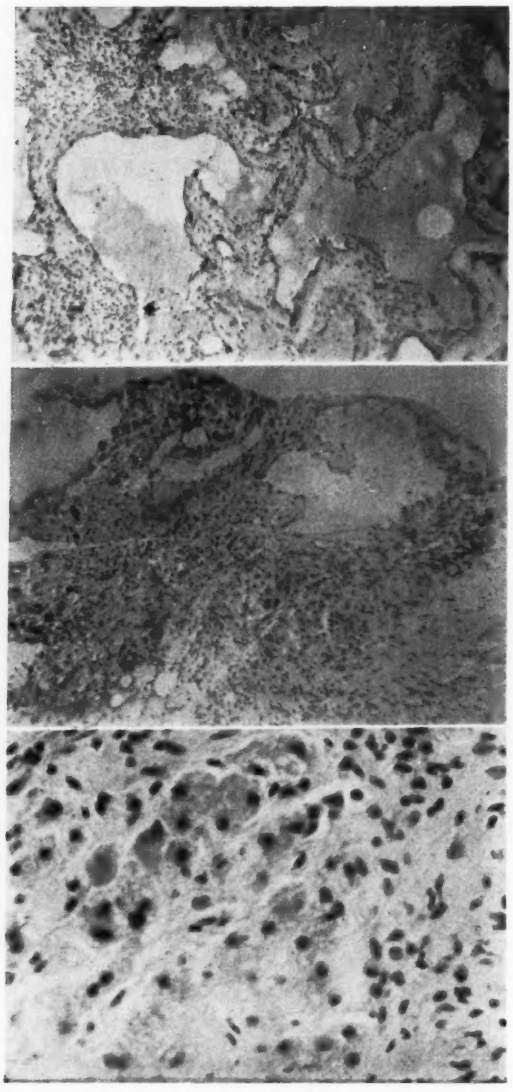

Fig. 3. Photomicrograph of tumor showing hemangiomatous tissue (low power).

Fig. 4. Photomicrograph showing liver cells in an area of the tumor (low power).

Fig. 5. Photomicrograph showing liver cells mixed with fibrous tissue (high power).

A preoperative diagnosis of pancreatic cyst or pseudopancreatic cyst was made and the abdomen explored through an upper right paramedian incision. A large dark colored multilocular tumor bulged from the lesser peritoneal space. It lay very firmly against the undersurface of the liver, pushing the gallbladder and bile ducts down and to the right. The stomach was pushed downward and to the left. The left anterior margin of the right lobe of the liver was quite fibrotic and contained numerous dark nodules.

Abdominal exploration was otherwise negative except for small pedunculated fibroids attached to an atrophic uterus.

A biopsy specimen was removed from the involved area of the liver. The tumor was removed intact with considerable difficulty. Its main point of attachment and source of blood supply seemed to be the gastrohepatic omentum very close to the undersurface of the liver. The postoperative course was uneventful and the patient has remained symptom free to date.

The removed tumor measured 20 by 15 by 10 cm. It was described by the pathologist as dark red in color and of soft cystic consistency. (Fig. 1.) On section it was found to consist of very soft pulp which exuded large quantities of blood. (Fig. 2.) The microscopic description and diagnosis was that of a cavernous hemangioma. (Fig. 3.) The finding of a few scattered cords of normal liver cells led to the conclusion that the tumor had originated in the liver and with growth had become pedunculated into the lesser peritoneal space. (Figs. 4 and 5.)

Microscopic study of the biopsy specimen from the liver revealed an admixture of liver cells, fibrous tissue and hemangiomatous tumor identical in character with sections from certain areas of the tumor.

COMMENT

The case here reported had many features in common with other cases which have been reported.[2,4,5,6] In none of these cases was an accurate preoperative diagnosis made.

Hemangionas are considered to be a true neoplastic process of congenital origin.[8] They usually pursue a benign course and grow slowly to adult life. They tend to cease growth with full body development but in many cases the tumor does not become manifest until adult life when they suddenly begin to enlarge. These tumors enlarge and develop by extending solid buds of endothelium into adjacent tissues.

These solid cords of endothelial tissue then become canalized and establish communication with the parent vessel. The cavernous type of hemangioma has no anastomatic connection with surrounding vessels and possesses only one afferent and one efferent vessel. The latter fact is of great importance in the treatment of these tumors.

While hemangiomas are considered benign tumors, a rare metastasizing form with microscopically benign secondary lesions has been reported.[8] Hemangioendothelioma of the liver has also been reported.[3] It differs from cavernous hemangioma in that the vessels remain in the earlier stages of development, are imperfectly differentiated and blood does not circulate through them. They are composed entirely of endothelial cells, are true endotheliomas and many of these in internal organs exhibit malignant features.[1]

SUMMARY

A case of a large pedunculated cavernous hemangioma of the liver successfully removed at operation is presented.

REFERENCES

1. Bell, E. T. Text Book of Pathology. Philadelphia, 1934. Lea & Febiger.
2. Brown, Herbert H. Excision of a large angioma of the liver in a diabetic. *Brit. M. J.*, 1: 232, 1927.
3. Goodale, Raymond H. Haemangio-endothelioma of the liver. *Arch. Path.*, 9: 528–533, 1930.
4. Nettrour, W. S. Angioma of the liver. *Proc. Staff Meet., Mayo Clin.*, 11: 710–711, 1936.
5. Peck, Charles H. Cavernous haemangioma of left lobe of liver: weight—three pounds fourteen ounces; extirpation of left lobe of liver; recovery. *Surg., Gynec. & Obst.*, 33: 277, 1921.
6. Rubin, I. C. Large pedunculated cavernous angioma of the liver reaching into the pelvis and causing obstetric difficulty. *Med. Rec.*, 93: 40, 1918.
7. Wakeley, Cecil P. G. A large haemangioma of the left lobe of the liver causing obstruction to the cardiac orifice of the stomach. *Brit. J. Surg.*, 12: 590, 1925.
8. Watson, William L. and McCarthy, William D. Blood and lymph vessel tumors. A report of 1,056 cases. *Surg., Gynec. & Obst.*, 71: 569–588, 1940.

PRIMARY IDIOPATHIC SEGMENTAL INFARCTION OF THE GREATER OMENTUM*

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THE purpose of this paper is to call attention to an apparently rare pathological entity of surgical significance, the etiology and pathogenesis of which is obscure. The author's personal experience with primary segmental infarction of the greater omentum is limited to two cases, herein reported.

In a study of the recent literature the only report of similar cases found was the paper by Pines and Rabinovitch. Hines reported a case of hemorrhagic infarction of the greater omentum in which death occurred. In this instance, however, the greater part of the omentum was involved and the infarct was secondary to portal vein thrombosis.

Berger reported a case in which a large branch of the left gestro-epiploic vein was completely occluded by a thrombus not associated with venous thrombosis elsewhere in the abdomen or torsion of the omentum. Cardiac insufficiency, however, was present and apparently the predisposing factor.

CASE REPORTS

CASE 1. A male caucasian, hotel clerk, age, twenty-seven years, was admitted to the hospital August 25, 1936. His chief complaint was abdominal pain of three and one-half days' duration. At the onset griping abdominal pain occurred intermittently at intervals of approximately an hour and lasted for several minutes as sharp right lower quadrant pain starting at the umbilicus and radiating to the right anterosuperior iliac spine. He worked the day of onset of pain and rested in bed the following day, but worked the day preceding his entrance to the hospital. Admission to the hospital was sought because of persisting pain. Between attacks of sharp pain there persisted a dull aching in the right lower quadrant which was accentuated by eating.

He had had the usual childhood diseases but no surgical procedure was ever necessary.

Physical examination revealed a fairly well developed and nourished white male of twenty-seven years, in no apparent distress. His temperature was 98°F.; pulse 58; respiration, 22. General physical examination was negative. Musculature of the abdomen was good; there were no scars and no abnormal masses or palpable organs. Tenderness in right lower quadrant was 3 plus; rigidity in right lower quadrant, 1 plus but no costovertebral angle tenderness. The prostate was slightly tender, but there were no masses nor other tenderness.

Urine and blood Wassermann reactions were negative. Both kidneys appeared normal in size, shape and position and no urinary calculi were observed.

Preoperative diagnosis: Acute appendicitis.

Thorough exploration of the abdomen, including inspection of the lesser peritoneal cavity through an incision in the gastrocolic omentum, revealed no abnormalities except necrosis and hemorrhagic extravasation of the omentum at the distal free border which included an area approximately 6 by 2 cm. The appendix appeared to be only mildly injected on its serosal surface and was otherwise normal.

Ether by the open drop method was given and a right rectus incision made. Resection of the area of necrotic omental tissue and appendectomy were performed. Closure in layers without drainage was carried out. The patient had an uneventful convalescence and was discharged on the tenth postoperative day.

Postoperative diagnosis: Hemorrhagic infarct of omentum.

Pathological Report. The mass of omental tissue measured 6 by 2 cm. On section areas showed a considerable amount of bloody infiltration into the fatty tissue, the latter form-

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ing a fairly firm structure through the center of which coursed a vessel occluded by a thrombus.

The microscopic examination revealed omental tissue infiltrated with round cells and extravasated blood, containing thin-walled blood vessels filled with thrombi.

Fig. 1. Case 1. Photomicrograph showing omental vessel in infarcted area occluded by a thrombus.

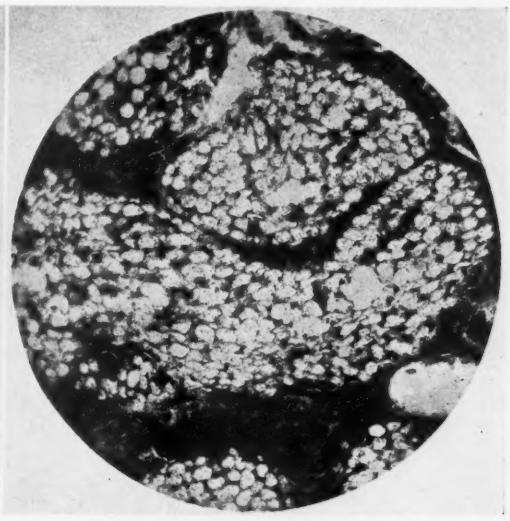

Fig. 2. Case 11. Photomicrograph showing infiltration of extravasated blood into omental fat.

Case 11. E. L., a white male, age twenty-nine years, was admitted to the hospital on December 3, 1940. His chief complaint was burning pain in the epigastrium and anorexia. Onset had occurred forty-eight hours before admission. The burning sensation had gradually developed into a burning pain which several hours after onset shifted from the epigastrium to the area immediately to the right of the umbilicus. There had been no nausea or vomiting. "Indigestion" had been present over an extended period of time. Eleven years previously he had developed an acute rheumatic endocarditis with aortic insufficiency which was adequately compensated at the present time.

His temperature was 100.8°F., pulse 104, respirations 22, red blood cells, 5,280,000, hemoglobin 96 per cent, white blood cells 15,500. polymorphonuclear leukocytes, 65 per cent, blood pressure, 170/0. There were visible pulsations of the arteries of the neck and a Corrigan pulse. Examination of the heart revealed the apex of the heart to be two fingers' breadth outside the midclavicular line. The diastolic murmur was transmitted down the sternum toward the left, but there was no evidence of cardiac embarrassment or insufficiency.

There was tenderness in the epigastrium and right para-umbilical region with maximum intensity in the latter area and moderate right upper re tus rigidity. There were no masses and peristalsis was diminished. Claybrook's sign was positive. Direct, referred, rebound and referred rebound tenderness was present.

Impression. Subacute perforation of peptic ulcer or acute appendicitis with perforation and local peritonitis; old rheumatic heart disease compensated.

At operation there was a large hemorrhagic area in the dependent free edge of the omentum, dark red to purplish in color which felt firm and rather hard. There was no evidence of torsion of the omentum or inflammation or other disease of the adjacent organs. The involved area measured approximately 7 by 4 cm. The parietal and visceral peritoneum appeared somewhat edematous and there was an appreciable amount of clear, free peritoneal fluid. The appendix was short and somewhat thick and the serosa slightly injected.

Cyclopropane was administered and a right rectus incision made. A thorough exploration of the peritoneal cavity was done, the infarcted area of the omentum was resected and appendectomy performed. Closure in layers without drainage completed the operation.

Postoperative diagnosis: Hemorrhagic infarction of the omentum.

Pathological Report. An irregularly-shaped nodular mass, blackish grey in color, consisted largely of blood clot. On section it was evident

that a hemorrhagic infarct had taken place. Sections of the omental mass showed it to consist largely of blood clot supported by the stroma and a reticular set-up of omental fat. Certain areas showed some tendency toward necrosis due to pressure of the blood clot and lack of an active nutritive blood supply.

Diagnosis: Infarct of omentum.

The patient's temperature ranged from 101.6°F. to normal on the fourth postoperative day. His convalescence was uneventful except for slight superficial wound infection.

COMMENT

The greater omentum is usually thin, presents a cribriform appearance and always contains some adipose tissue. Between its two anterior layers a short distance from the greater curvature of the stomach is the anastomosis between the right and left gastro-epiploic vessels.

The right gastro-epiploic artery is a terminal branch of the gastroduodenal and anastomoses with the left gastro-epiploic branch of the lineal artery. The left gastro-epiploic vein which receives branches from the anterosuperior and postero-inferior surfaces of the stomach and from the greater omentum ends in the commencement of the lineal vein. The right gastro-epiploic vein is a tributary to the superior mesenteric vein and receives branches from the lower parts of the anterosuperior and postero-inferior surfaces of the stomach and from the greater omentum.

Variations in the size, thickness, amount of adipose tissue and location of omentum are considerable and are probably important in the etiology and symptomatology of this condition.

Lesions of the omentum secondary to pathological conditions of other intraperitoneal organs are, of course, frequent while strangulation and thrombosis secondary to torsion are not uncommon. In a paper entitled "Primary Acute Epiploitis," Eliason and Johnson reported thirteen cases, ten of which involved the greater omentum and in all of which torsion was the causative factor. Strangulation and thrombosis secondary to omental torsion give an entirely different gross appearance than idiopathic infarction does, and having once seen both for comparison one is not likely to confuse them. It should be remembered that omental torsion is more likely to occur in thin omenta with scanty amount of fat because this type of omentum is more easily twisted.

In the two cases here reported each presented an infarct of a localized, distal segment of the greater omentum. In neither case was there co-incident intraperitoneal pathological conditions. Neither case was associated with torsion of the omentum nor was there a history of antecedent violence which could implicate external trauma as an etiological factor.

It was observed that while neither individual was obese the omentum in each instance was thick and fatty. Whether the large amount of fat present in the omentum, in each of these cases, was of etiological significance or merely co-incidental is difficult to say. It was, however, in marked contrast to those cases of omental torsion in which the omentum has been thin with a scanty amount of fat. Pines and Rabinovitch suggest that stretching of an omental vein consequent to trauma leads to the formation of a thrombus.

From a consideration of these two personally observed cases the following is offered as a possible explanation of the etiology of the condition: In view of the close communication between the blood supply of the stomach and omentum it is evident that the strain on thin-walled veins is definitely increased at the time of vascular congestion incident to a full meal. During this period additional strain from increased intra-abdominal tension incident to straining, coughing, sneezing or lifting may be sufficient to cause a primary rupture of the dependent veins of the omentum with hemorrhagic extravasation and secondary thrombosis. E. L. (Case II) gave a history of heavy work in handling boxes weighing approximately 120 pounds shortly following the noon meal just prior to the onset of pain.

SUMMARY

A report is given of two cases of primary idiopathic segmental infarction of the greater omentum, emphasizing clinical and pathological features.

Each case, without a history of antecedent violence, presented an infarct of a localized, distal segment of the greater omentum not associated with omental torsion and characterized by an absence of any co-incident intraperitoneal pathological condition.

An explanation is suggested with regard to the etiology of this condition.

REFERENCES

BERGER, A. R. Hemorrhagic infarction of the greater omentum. *Arch. Surg.*, 36: 497, 1938.

ELIASON, E. L. and JOHNSON, J. Primary acute epiploitis. *Surgery*, 6: 68, 1930.

HINES, L. W. Hemorrhagic infarction of the greater omentum. *Illinois M. J.*, 66: 166, 1934.

PINES, B. and RABINOVITCH, J. Idiopathic segmental infarction of greater omentum. *Surg., Gynec. & Obst.*, 71: 80, 1940.

THE most effective stimulus for intestinal secretion is the entrance of pancreatic juice into the intestine. It is possible that secretin, known to have a controlling influence over the production of pancreatic juice, also acts directly as a stimulus to the secretion of intestinal juice.
From—"Surgical Physiology"—by Joseph Nash (Charles C. Thomas).

ULCERATING CANCER OF BREAST AS A PORTAL OF ENTRY FOR FATAL TETANUS

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CASE REPORT

MRS. L. B., age sixty-seven, was first seen on the morning of her admission to the Memorial Hospital of Greene County at Catskill, New York, September 3, 1941, complaining of severe stiffness of the jaws. Her past history revealed that in November, 1940, the patient had noticed a mass in the right breast but did nothing about it. In April, 1941, it became ulcerated and the patient used herbs, grasses and all kinds of salves, but it failed to improve. Two days before admission, she became somewhat toxic and had a slight fever and sore throat. Then the stiffness of the jaws developed and she sought medical advice. The family history and past illnesses were irrelevant except that the patient's husband had died four years previously from cancer of the large intestine.

Physical examination showed a well developed, rather thin adult white female, height about five foot three inches, weight about 130 pounds. The facial expression showed a characteristic so-called "risus sardonicus." The skin was clear and there was no rash. Mucous membranes were of fair quality. Mental orientation was good and mental status clear. Blood pressure was 140/60; temperature was 99.8°F. rectally. The pupils reacted rather sluggishly to light and accommodation but were equal. A congenital cleft palate was present for which an occlusion dental plate had been fitted. This was removed with difficulty because of marked trismus of the patient's jaws. The septum was markedly deviated, allowing poor ventilation through the left nostril. The right was adequate. With difficulty the throat was examined and showed no inflammation, but was filled with mucus. There was moderate cervical gland enlargement and some enlargement of the lymph-nodes in the right supraclavicular area. The right breast showed a large ulcerating cancer about the size of a large fist starting at a point directly above the nipple and extending to the right axillary and pectoral muscles. The right axillary lymph-nodes were also enlarged *en masse* to about the size of an orange. The skin over the right breast, which did not ulcerate, had a pig-skin type of appearance with associated edema. The edges of the ulcerating area were sharply marginated and indurated. The crater of the ulcerating area did not bleed easily and was covered with a thick film of powder which the patient had recently applied. As mentioned in the history, there had also been applied many household remedies, various herbs, grasses and salves.

The patient had concealed this cancer from the daughter with whom she lived, for the past year, covering the discharging area with any cloth or material she could most conveniently obtain. The left breast showed no involvement. The heart sounds were distinct, of fair quality and regular. No murmurs were heard and no adventitious sounds. The breath sounds were vesicular throughout, except for an occasional râle in the left posterior chest at the base. There were no definite areas of dullness due to consolidation on percussion.

X-ray examination of the chest, however, taken on September 4, 1941, by Dr. William M. Rapp, roentgenologist, on the day following admission to the hospital, showed "areas of consolidation in both lungs, the greater in the lower lobe of the right lung. There was an increase of the transverse diameter of the heart, the right auricle particularly being enlarged. The right diaphragm was elevated and the dome was irregular in outline. In the lateral view of this chest wall there were distinct mottlings of the right breast." There was no gross deformity of the extremities. The reflexes appeared to be hyperactive, but there were no abnormal reflexes such as Oppenheim or Babinski; however, there was a moderate degree of opisthotonus associated with a definite Kernig reaction. There was some slight abdominal distention, but no rigidity of the abdominal musculature. No tender points or masses were detected abdominally or rectally. The blood count showed a leukocytosis of 12,000, with 85 per cent polymorphonuclear leukocytes. Spinal tap gave a clear fluid not

under increased pressure, with a normal cell count. The Wassermann test was negative. The temperature varied between 100° to 102°F. until terminally when it rose to 104°F. Marked dysphagia occurred associated with cyanosis. The patient was given 60,000 units of tetanus antitoxin intravenously and 20,000 intramuscularly in the course of two days. Oxygen and intravenous glucose and saline, sulfathiazole and other supportive measures were used without avail and the patient expired on the third day after admission. Convulsive seizures were controlled by intravenous pentothal. Intramuscular sodium luminal was also found to be helpful. Permission for autopsy was obtained and performed by Dr. John J. Marra, and the findings were as follows:

GROSS DESCRIPTION

The body was that of a fairly well developed, well nourished white female having a body length of 155 cm. and weighing approximately 130 pounds. There was no edema. Postmortem rigidity was present in the upper extremities. Lividity was slight and dependent. The pupils appeared somewhat unequally dilated, the left being more contracted than the right. Arcus senilis was present. The ears and nose were negative. The jaws were rigid. A few carious teeth and a cleft palate were present.

In the right breast in the right upper outer quadrant there was a large oval, fungating, ulcerating area measuring about 6.5 cm. in diameter and having an ulcerated floor about 3 cm. from the surface. The edges of this mass were rolled, indurated, reddish in color and the entire mass was firmly adherent to the surrounding breast tissue. The right axillary lymph-nodes were also enlarged and appeared to be replaced with neoplastic tissue. The tumor mass in the breast was firm, greyish in color and extended into the breast tissue for a depth of about 5 cm. There were numerous pigmented lesions over the abdominal portion of the skin.

In the peritoneal cavity no fluid or adhesions were present. The peritoneum was dry and sticky. The diaphragm reached the fourth rib on the right and the fifth interspace on the left. The liver edge was at the costal margin. The appendix was free and normal.

There was about 15 cc. of clear, serous fluid on each side in the pleural cavities. The trachea was in the midline and the great blood vessels showed nothing unusual. The pericardial cavity was not remarkable grossly.

The heart appeared to be of normal size. The coronary vessels showed a slight amount of intimal thickening. The myocardium was pale

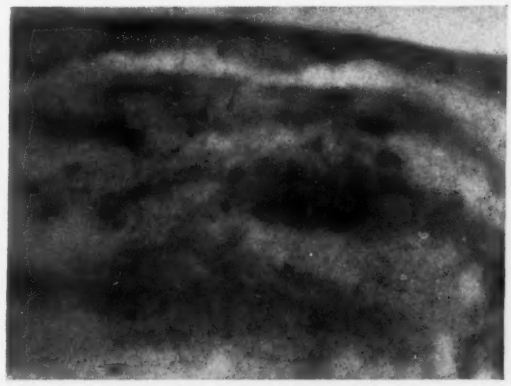

Fig. 1. The dark racquet-shaped bodies represent the organism, Clostridium tetani, in a section of tissue taken from the breast cancer, stained by Gram-stain method for fixed tissue. (Microphotograph; oil immersion objective; magnification × 1,000.) (Photograph and slide by Dr. John J. Clemmer.)

and tore readily. The thickness of the right ventricle was 0.6 cm. and that of the left 1.4 cm. The valves appeared normal, grossly, and had normal dimensions. The endocardium was smooth.

In the aorta there were a few atheromatous plaques present.

The lungs were both dark reddish in color, wet, heavy, and somewhat firm. The bronchi contained much frothy mucoid material. Sections showed marked congestion and edema. The left lung, especially, showed purulent material on pressure. There were a few foci of atelectasis in the lower lobe. In the region of the right apex, the lung parenchyma was discolored, somewhat firm and with pressure a purulent exudate exuded. The lung parenchyma was barely visible in this area and gave the appearance of beginning abscess.

The spleen measured 7 by 4 by 3 cm. It was flabby and sections showed a dark reddish-brown, granular cut surface, from which a reddish, paint-like material could be scraped. The gastrointestinal tract showed considerable distention with gas. The pancreas was not unusual grossly. The liver appeared to be of normal size, measuring 22 by 14 by 8 cm. The capsule was smooth and sections showed a mild amount of congestion with a beginning nutmeg appearance.

The gallbladder was distended with bile, and upon opening, there was found about nine small facetted, biliary stones, the largest measuring

about 0.5 cm. in diameter. The wall of the gallbladder was of normal thickness and showed nothing unusual. The ducts were patent and free of stones.

The adrenals revealed nothing grossly. The kidneys measured 10 by 7 by 4 cm. each. The capsule stripped with some difficulty and left a greyish-pink, somewhat granular surface. There were a few scarred areas noted grossly. Sections showed a fairly well demarcated cortex and medullary portion. The cortex measured about 0.4 cm. in thickness. The pelves, calices and ureters were not remarkable grossly.

The urinary bladder contained about 50 cc. of cloudy urine. The ovaries were atrophic, but otherwise not unusual. The uterus was small and the endometrium thin. The cervix showed nothing unusual.

Provisional Anatomical Diagnosis: Tetanus (clinically); diffuse, ulcerating adenocarcinoma of the breast with extension to pectoral muscles and pectoral fascia; metastases to right axillary lymph-nodes; diffuse bilateral bronchopneumonia; chronic cholecystitis with cholelithiasis; general arteriosclerosis, mild; congestion of visceral organs; dehydration.

Microscopic Examination. Heart: The epicardium contained a few small hemorrhagic areas. The myocardial fibers were fragmented, swollen, granular, and striations were barely visible in some zones. The muscle was edematous and congested.

Bronchus: The mucosa was eroded. The submucosal zone was edematous and infiltrated with many leucocytes, most of them were lymphocytes.

Lungs: Sections from all the lobes showed the capillaries to be engorged. The alveolar spaces contained much edematous fluid, and scattered about were numerous macrophages containing a dark brownish, granular pigment. Scattered about in all sections were large zones showing distention of the alveoli with a fibrin network packed with leucocytes, all of which were polymorphonuclears. In the sections taken from the right apex, the process had destroyed some of the alveolar walls to such an extent that small miliary abscesses had formed.

Spleen: The pulp was fragmented into small islands in some zones. The sinusoids were congested. The Malpighian bodies were not remarkable. The arteriolar vessels showed extensive hyalinization.

Pancreas: There was some inter- and intralobular fatty infiltration.

Liver: The sinusoids showed engorgement. There was mild vacuolization of the liver cells. The periportal tissue showed some phocytes, with an occasional polymorphonuclear and eosinophil.

Adrenals: These showed no pathological changes of note.

Kidneys: The vessels were engorged. The glomerular capsules showed some fibrous thickening. The tubular lining cells were swollen, granular, and some were desquamated. The lumina contained débris, and an occasional one showed plugs of purplish staining granular débris.

Urinary Bladder: Showed no pathological changes of note.

Uterus: The endometrium was atrophic and showed a few cystic glandular spaces.

Breast: Sections from the breast showed columns and plugs of moderately hyperchromatic epithelial cells. The cells varied considerably in size and shape. Some were multinucleated and mitotic figures were scarce. The cells formed a typical glandular structure. The atroma was made up of pale collagenous tissue. The neoplastic tissue reached the overlying skin and part of the skin was replaced with tumor tissue. The ulcerated portion of the tumor showed much necrosis and leucocytic infiltration. The tumor tissue invaded the underlying pectoral muscle, and sections from axillary lymph-nodes showed replacement by metastatic tumor. Special stains from the tumor tissue revealed typical tetanus organisms and their spores. With Gram-stained tissue, the latter took the form of short rods with terminal globular formations appearing as typical racket-shaped forms. (Fig. 1.)

Report by Dr. John J. Clemmer. "From the gross and microscopic studies, this individual presented several interesting phenomena. The lesion in the right breast was a slowly growing adenocarcinoma with regional metastases. Marked ulceration and inflammation occurred in the central portion of the tumor. Numerous cultures taken from the necrotic portions of the ulcerated area failed to give growth of Clostridium tetani or its spores. This was not unexpected since it is difficult to grow these organisms from tissue (B-41-5598). *However, special stains on the breast tissue itself revealed the presence of these organisms and their spores.*

"It was difficult to evaluate the specific immediate cause of death. The diffuse bilateral bronchopneumonia with accompanying lowered

oxygen exchange and deficient oxygenation of the blood could have produced death. Most likely factors were a combination of both processes.

"The gallbladder findings were incidental and probably had no significance in the causing of death.

"*There are no specific pathologic findings in tetanus infections.*"

The literature on the subject of tetanus does not mention a proved case of ulcerating cancer of the breast as a point of entrance for fatal tetanus. A presumptive diagnosis in this case was made from the clinical course until positive diagnosis was made on autopsy. There are many parts of the world where the soil is particularly rich in tetanus organisms. This is true in general of densely populated areas. Georgia, Indiana, South Pennsylvania, South California and the Hudson River Valley are said to be particularly well provided with tetanus rich soil. Exposure is, of course, an important factor in the incidence of tetanus.

Until recently the fire-cracker celebrations of July Fourth took a yearly toll of lockjaw victims well into the hundreds. Seasonal studies show that lockjaw is commonest in July. However, the summer season is generally favorable to the development of tetanus. External contamination seems to be an immediately responsible factor. The use of shields after vaccination seems to predispose to tetanus infections, probably because the parents or children keep these shields on or reapply them after they have become dirty and contaminated. Surgical operations, especially those in the fields of proctology, gynecology and urology may be followed by tetanus. Usually in these cases, fecal contamination has occurred either in the operating room or in the ward, very often from the incidence of patients transferring fecal material from the anal region to the surgical wound area. Tetanus organisms are not often found in the human rectum, but when they are there, the eating of uncooked vegetables is considered to be the cause.

Age appears to be a predisposing factor. Most susceptible periods are immediately after birth and early middle life. In some cases lockjaw developed and no wound could be discovered. In this so-called idiopathic type, intestinal infection is probably the responsible agent, unless a microscopic abrasion can be considered responsible, as in this case, the patient undoubtedly infected herself directly by a dirty cloth of tetanus infected material applied to the ulcerating cancer. The bacillus of tetanus is very resistant and in dried pus or spore form it survives most of the common antiseptics. As mentioned by Dr. Clemmer, there are no typical morbid factors in tetanus, the nerve cells show degenerative lesions and there are often minute hemorrhages in the brain and cord. Tetanus of the newborn is about 100 per cent fatal and in adults the general consensus of opinion is that it is about 80 per cent fatal.

SUMMARY

An unusual case of ulcerating cancer of the breast as a portal of entry for fatal tetanus with *autopsy* proof of the organism spores found in the wound is described and discussed. No similar proved case is found in the literature.

I wish to express my thanks to Dr. John J. Clemmer, Director of Bender Laboratory, Albany, New York, for his kind co-operation in obtaining the slide prepared from the cancer tissue, and microphotograph as illustrated.

REFERENCES

1. Babcock, Wayne W. Textbook of Surgery. P. 134. Philadelphia, 1935. W. B. Saunders Co.
2. Cheatle, G. L. *Brit. J. Surg.*, vol. 13, no. 51, 1926.
3. Cutler, Max. *Surg., Gynec. & Obst.*, vol. 48, no. 6, 1929.
4. Davidson, H. A. Tetanus—Cyclopedia of Medicine. Vol. 12, p. 30. Philadelphia, 1934. F. A. Davis Co.
5. Ewing, James. Neoplastic Diseases. 3rd ed. 1928. W. B. Saunders Co.
6. Handley, W. Sampson. Cancer of the Breast, 2nd. ed. London, 1922. Oxford University Press.
7. Stone, Willard J. Tetanus-Textbook of Medicine-Cecil, R. L. P. 108. Philadelphia, 1929. W. B. Saunders Co.
8. White, William Crawford. Cancer of the Breast. New York, 1930. Harper & Bros.
9. Zinsser, Hans. Textbook of Bacteriology. P. 617. New York, 1927. D. Appleton & Co.

SLOUGH FOLLOWING INJECTION FOR HEMORRHOIDS

CASE REPORT

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THE injection treatment of hemorrhoids is now a generally accepted method of therapy for this condition. It was formerly looked down upon inasmuch as "quacks" used this method originally and introduced it to the profession. In this paper, we are not going to deal with the merits or demerits of this form of therapy; but merely want to call to the attention of fellow-practitioners that this form of therapy carries with it many dangers.

The greatest danger lies in the fact that the injection method seems so easy that many, with no particular knowledge of rectal complaints, start treating patients by this method, and, in consequence, bring about many complications which tend to bring this method of treatment into disrepute.

Only simple uncomplicated internal hemorrhoids should be given a trial by this method. External hemorrhoids should never be injected, nor should internal hemorrhoids be injected if accompanied by other anal or rectal pathological conditions.

The literature is filled with articles on this form of therapy and carries only the good reports. There are very few papers and few textbooks which go into detail on some of the serious complications which might arise following faulty injection treatment for internal hemorrhoids. The injections should be made beneath the mucous membrane overlying the hemorrhoid, preferably above the hemorrhoid but not into it. Only by experience can one jugde how much of the sclerosing solution should be injected. The two solutions now most universally used in this method of treatment are a 5 per cent solution of quinine and urea hydrochloride and a 5 to 10 per cent solution of phenol in vegetable oil. If properly given, injection therapy carries with it very little if any discomfort to the patient.

At this point, it might be mentioned that only about 25 per cent of all cases of hemorrhoids are suitable for injection treatment, and it might be added that recurrences will take place right along in those cases which were not originally properly selected for this type of therapy; in other words, if treatment is instituted in a case in which there is any reasonable doubt that the treatment will not be successful, there is no question in my mind but that case will have a recurrence.

The various complications that arise are:

1. Abscesses occur very rarely. The author himself has been very fortunate not having any as yet. Morgan,[1] of San Francisco, recently reported a case of severe abscess formation with destruction of the entire anus as a result of infection following an injection of internal hemorrhoids.

It is altogether possible that a pylephlebitis may follow an injection for hemorrhoids; no doubt this condition would cause plenty of toxicity; and it is very possible that this is what took place in the case I am to report. Several years ago, a patient who was being given injections suddenly developed a liver abscess, and it was readily concluded that the injections caused the abscess, the infection being carried through the blood stream from the hemorrhoidal veins to the portal circulation.

2. Rosser and Wallace,[2] of Dallas, reported several cases of oil tumor formation following injection of hemorrhoids with oily solutions. They also reported cases of

stricture formation as a result of extensive fibrosis of the anal canal caused by injections. I have under my care at present a man who has two large anal polyps which are the result of injection of large internal hemorrhoids which never should have been injected.

3. If the injection is given too low in the anal canal, pain will follow, especially if the injection is given within the region of the sphincters.

4. Edema of the anal tissues may follow if the injection is given too low in the anal canal.

5. Sloughs will occur as long as hemorrhoids are injected. The author does not believe there is a proctologist anywhere who at times has not had a slough following an injection. The causes for the slough and subsequent hemorrhage are: (1) too superficial injection for the hemorrhoid; (2) the injection of too much solution causing a depletion of the circulation to the mucous membrane; this is then followed by sloughing of the mucous membrane and at times hemorrhage which may be slight or quite serious. It makes very little difference as to the type of solution used, as these complications will arise now and then when the injection is not properly given. Sloughing may bring about quite a toxic condition as it did in the case about to be reported.

CASE REPORT

On June 6, 1939, Mr. T. R., age thirty-four, was seen at his home. The patient was in distress, had a cold sweat, a temperature of 101°F. and was complaining of severe pain in the rectum. He stated that on May 29, 1939, he started to have rectal bleeding; he consulted a physician who prescribed a salve which did not stop the bleeding; on May 31, 1939, he was given an injection which not only did not stop bleeding, but caused considerable pain. The physician left town, and, on June 3, 1939, he went to "one of those places" where he was given a "real shot" to cure him, and this injection caused such severe pain that he remained bedridden up to the time I saw him.

Examination revealed the patient to be in great distress, with a temperature of 101°F., cold sweat, and a general appearance of being quite toxic. A rectal examination was done under great difficulty, and a large sloughing area was felt in his right posterior quadrant of the anal canal and rectum. Needless to say, this examination caused the patient considerable pain. Hot sitz baths and sedatives were prescribed, but on the next day the patient was no better and was hospitalized. On June 8, 1939, under sacral anesthesia he was operated upon. At surgery, a large sloughing mass about three inches in diameter was found in the anal canal and rectum extending from a point one inch above the anus and situated in the right posterior quadrant of the anal canal and rectum. There were some very much indurated hemorrhoids on each side of this sloughing area. The hemorrhoids were excised with the cautery and the posterior commissure was incised to provide good drainage for the sloughing area. The rectum and anal canal were then packed with iodoform gauze.

On June 9, his temperature went to 103°F., and the patient was quite uncomfortable. On June 10, the packing was removed, and later in the day, there was considerable bleeding from the rectum. Examination that afternoon revealed the patient in moderate shock. Rectal examination revealed bleeding from the sloughing area and the rectum was again packed with gauze his condition continued to improve until June 13 when he again started to bleed. Repacking did no good and he continued to bleed. On June 14 he was given 1,000 cc. of 5 per cent glucose intravenously and the rectum again packed with gauze. This did not stop the bleeding and on June 15 he continued to pass clots, looked very pale, and was perspiring freely. He was given 500 cc. of blood. On June 16 the patient continued to bleed and he was again given a transfusion with 550 cc. of blood. That same evening he was taken to surgery, where, again it was found the bleeding was coming from the center of the sloughing area seen at the previous operation, and a suture was put through this sloughing and bleeding area (with a prayer that it would hold) and the rectum packed with iodoform gauze, with a tube in the rectum to allow for the escape of gas. The next day he was much better and this improvement continued. On June 23 he was given a transfusion of 250 cc. of blood. The daily improvement was so marked that he was discharged from the hospital on July 4, 1939. He continued to improve, the wound kept on healing, and he was discharged from my care

on July 17, 1940, when the rectal wound was examined and found to have healed perfectly.

To give one an idea of how much bleeding took place in this case the blood counts have been tabulated as follows:

BLOOD COUNTS

Date	Hemoglobin	Red Blood Corpuscles	White Blood Corpuscles
6-7-39	78	4,160,000	12,000
6-10-39	73	3,610,000	13,400
6-11-39	72	4,050,000	15,700
6-13-39	62	3,350,000	
6-15-39	Transfusion	500 cc.	
6-16-39	45	2,310,000	
6-16-39	Transfusion	550 cc.	
6-21-3–	56	3,190,000	12,000
6-23-39	Transfusion	250 cc.	
6-24-39	59	3,410,000	11,600
7-1-39	64	3,700,000	

CONCLUSION

Injection therapy treatment of hemorrhoids carries with it some danger. Care must be taken in selecting the cases for injection treatment, and still further care must be observed in the administration of the injection. Further, those cases in which injections are being given must be watched very carefully so that any complications that may arise will be taken care of immediately.

REFERENCES

1. Morgan, J. W. Catastrophies following hemorrhoid injections. *Calif. & West. Med.*, 50: 204, 1939.
2. Rosser, C. and Wallace, S. A. Tumor formation; pathologic changes consequent to injection of oils under rectal mucosa. *J. A. M. A.*, 99: 2167–2171, 1932.

New Instruments

A NEW BITING CYSTOSCOPE*

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THE purpose of this paper is to describe an improved form of biting cystoscope, designed to eliminate the shortcomings of those in current use.

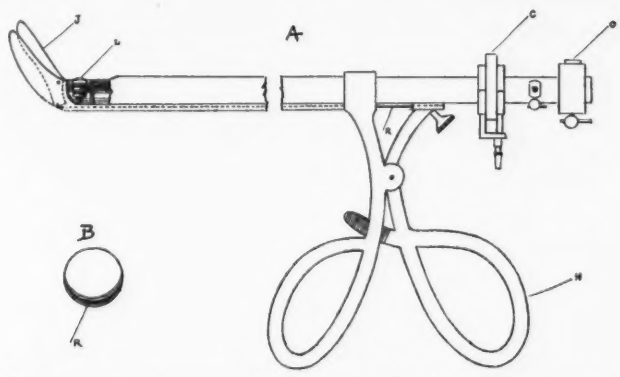

FIG. 1. A, schematic drawing of new biting cystoscope sheath. The jaws, J, are controlled by scissor handles H, but a brake handle may be substituted for this manipulation. L, lamp at right angles to longitudinal axis of sheath and adjacent to fenestral opening. R, thin wall rod of crescent-shaped cross-section, connecting handle with jaw. C, electric coupling. O, combination locking devise and stopcock. B, cross-section of lumen of sheath. R, position of crescent-shaped rod in lumen of sheath. Note ample room left for telescope, etc.

The Buerger operating cystoscope, as well as those of Ravitch, Young, Lowsley, McCarthy and others, have one or another of the following shortcomings: (1) In all of them, the gauge of the sheath is too great. (2) It is difficult to introduce into the bladder because it is not curved. (3) Illumination and vision are limited, and are quite shut off when the jaws of the instrument are closed. (4) There is a lack of means for continuous irrigation.

The instrument I have designed, shown in the accompanying illustrations, has a No. 20 F. gauge and is curved to facilitate insertion into the bladder. At the terminal end of the sheath there are two jaws, whose biting surfaces may be shaped to suit their specific purpose: cutting, grasping, breaking, etc. The distal jaw is stationary, while the anterior jaw is movable. Its action is controlled by a thin-walled steel rod of a crescent-shaped cross-section which moves within a guide of similar form in the sheath. This rod, made of sheet metal, will not buckle even under great pressure at the handle.

For illumination, there is a lamp adjacent to the fenestral opening, approximately at right angles to the longitudinal axis of the sheath. By this arrangement, the lamp and

* Read at the Beth David Hospital Clinical Conference, November 17, 1941, New York City.

the fenestral opening are brought close to the biting jaws, affording unobstructed vision and continuous illumination.

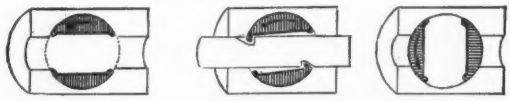

Fig. 2. Cross-section of combination locking devise and stopcock of Figure 1-o; left, stopcock open; center, stopcock locking telescope, obturator, etc., to sheath; right, lumen of sheath completely closed.

There is enough space left within the sheath of the cystoscope to permit the introduction of a No. 14 F. observation telescope for vision. At the sides of the mouth end of the sheath there are two stopcocks for irrigation. The locking devise (Figs. 1 and 2) o, is of my own design. It can hold the component parts as a single unit, or act as a stopcock.

The advantages of this instrument may be summarized as follows: (1) It is of smaller gauge than those now in use. (2) It is as easy to introduce into the bladder as the nonoperating cystoscope of the same gauge. (3) It allows continuous irrigation. (4) It operates with facility under good illumination and full vision. (5) It has a simple combination locking devise and stopcock.

There are certain contraindications to the use of the gastroscope. It should not be employed in the presence of esophageal disease such as carcinoma, diverticulum, stricture, or varix, nor in cases of aortic aneurysm and cardiac decompensation.

From—"Carcinoma and Other Malignant Lesions of the Stomach"—by Waltman Walters, Howard K. Gray and James T. Priestley (W. B. Saunders Company).

A BED FOR HOME OBSTETRICS

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THE practice of domiciliary obstetrics deserves careful consideration. Many deliveries, by necessity, must still be conducted outside of hospitals and often in homes with small and inconvenient rooms, in small towns and on the farm where hospital facilities are not available.

The economic status of the prospective mother affects her well being and the safety with which she may expect to pass through the experience of giving birth. The relative safety of delivery at home is apparent. To further this safety and to give women whose economic situation will not permit adequate hospital care the best service possible under the circumstances prompted me to develop a bed for labor and delivery for the home. This bed serves both as a delivery bed and also as a lying-in-bed; this bed, since it is intended to replace the ordinary low bed usually found in homes, is simple to operate, light to facilitate transportation and comfortable to the patient. This type of bed has now been in use for more than six years and has proved quite satisfactory. It is inexpensive, easily and quickly demountable, looks like an ordinary bed and gives the obstetrician all the practical operative positions necessary for home delivery practice. There is nothing about the appearance which may give the expectant mother any fright.

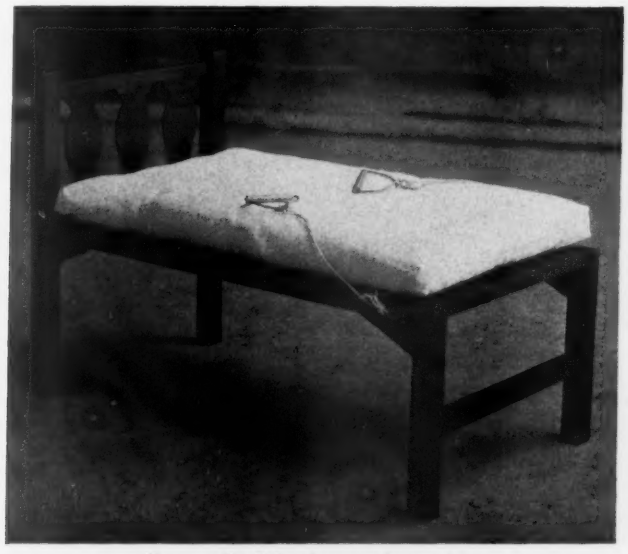

FIG. 1. Bed for home obstetrics.

This bed gives the full length horizontal position and the short delivery position. If it is desired to have the perineum of the patient extend out beyond the end of the bed in operative position, this can be obtained easily. Thus plenty of room is given for the use of instruments, needle holders, retractors, etc., in repair work. The patient's legs usually are steadied by nurses but if it is desired to use leg holders adjustable mountings are provided into which these may be inserted. Tractor straps of heavy sash cord, adjustable to shorten or lengthen the hand hold, are supplied with comfortable grip handles. The tractor cords fit securely into holding lugs on the side of the bed frame.

A Simmons link fabric spring and a good quality felt mattress is used. This gives the much desired firmness so essential in operative work.

The frame is of seasoned oak construction, attractively stained and varnished so as to harmonize with the average household furniture; it is washable and is mounted on sliding furniture shoes. The total length is seventy-four inches, total width thirty-six inches and the total height including the mattress thirty-six inches.

This bed has served most satisfactorily. The nurses like it and patients say it is very comfortable. After the delivery, the sheets are changed, and the patient is made comfortable. The patient uses this bed for about two weeks and then replaces it with her usual bed.

Our local furniture dealers carry these beds and rent them to the patients for a small fee. They are usually taken to the patient's home, at some convenient time before the expected confinement date, and are set up. A number are always available. We have five in circulation now. With these special beds and with our sterile packs which we prepare, we are endeavoring to render a good obstetrical service in a rural district in Missouri.

A RETENTION cyst is sometimes found in the under surface of the tongue near the tip. This lesion is due to dilatation of the gland of Blandin or Nunh, which is found beneath the tip of the tongue.
From—"Pathology of the Oral Cavity"—by Lester Richard Cahn (Williams & Wilkins Company).

COMBINATION NEEDLE HOLDER AND SUTURE SCISSORS

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THE purpose of this combination needle holder and suture scissors is to eliminate the unnecessary handling of the needle holder and suture scissors when the latter two are used as separate instruments. This instrument will eliminate that methodical maneuver of laying down the needle holder and grasping the suture scissors each time the tie is completed. It will also eliminate those infrequent but distressing instances in which the suture scissors is misplaced on the instrument tray or about the surgical field.

This instrument consists of the usually shaped needle holder with the distal halves of the jaws being the needle holding portion and the proximal halves, those nearest the lock, converted into the scissors. (Fig. 3.) Between these two halves is a stop-block on the one jaw and a corresponding notch on the other jaw. This stop-block has a two-fold purpose: First, it is to prevent the needle from being placed between the

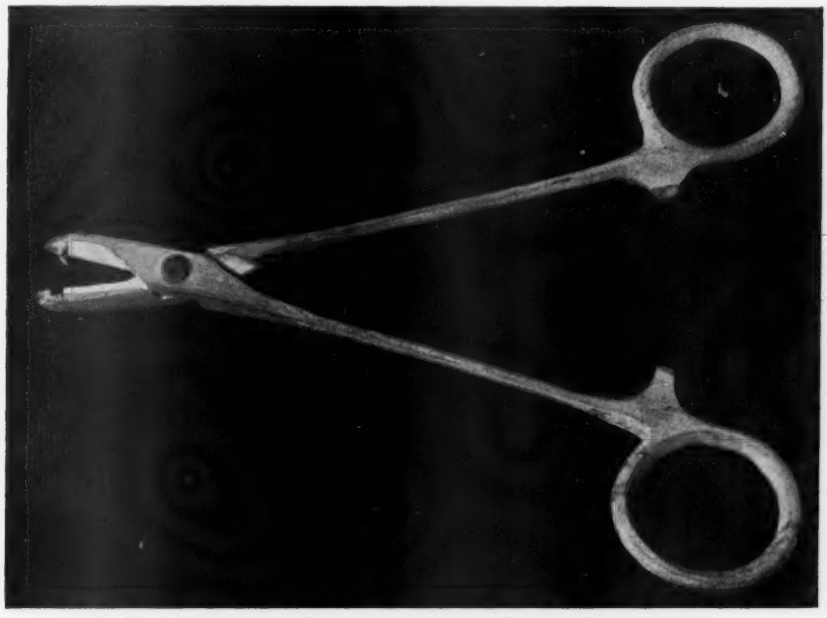

FIG. 1. Photograph of a carved model of the instrument.

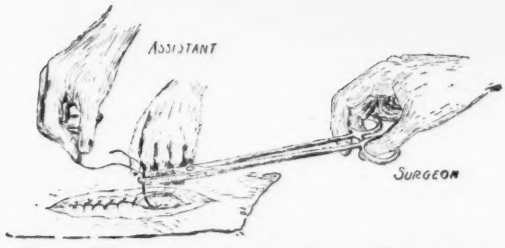

FIG. 2. The surgeon inserts the needle between the needle-holding jaws and places the suture.

FIG. 3. The assistant, having tied the suture, holds the ends of the suture while the surgeon severs the ends.

scissors portion, and secondly, when a double suture is being used it catches one thread of the double suture and allows the other thread to pass over the blade of the scissors to be cut.

When an assistant to the surgeon is present, the surgeon places the suture. (Fig. 2.) The assistant then ties the suture and the surgeon severs the suture ends. (Fig. 3.)

When an assistant to the surgeon is not present, for example when repairing minor lacerations in the emergency room or in the office, or in the delivery room repairing episiotomies or obstetrical tears, the suture can be placed and tied by means of the distal portion of the jaws and the suture cut by the proximal blades without the use of another instrument.

Although ether is now administered most frequently from the gas machine in combination with oxygen and one of the anesthetic gases, its usefulness when administered by the open or semiopen drop method should not be overlooked.

From—"Carcinoma and Other Malignant Lesions of the Stomach"—by Waltman Walters, Howard K. Gray and James T. Priestley (W. B. Saunders Company).

A MODIFICATION OF THE METZENBAUM SCISSORS FOR GENERAL SURGERY

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A FEW years ago, while visiting at the Lahey Clinic in Boston, we were impressed by the Metzenbaum scissors (Fig. 1, No. 1) used by the general surgeons. Seeing the ease and facility with which these instruments were used we secured a pair, and in our own hands this instrument was an improvement over the more cumbersome, more commonly used heavier dissecting scissors.

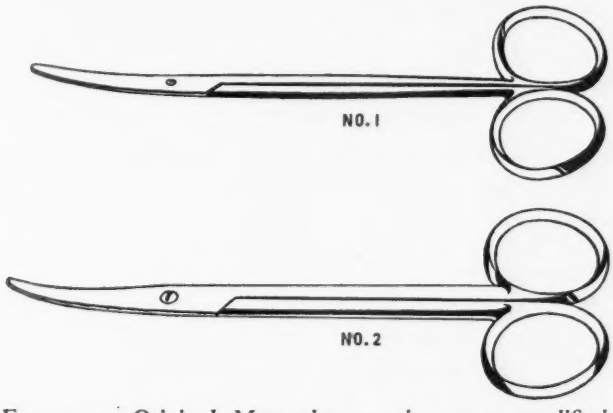

FIG. 1. 1, Original Metzenbaum scissors; 2, modified Metzenbaum shears. The cutting blades are heavier and there is an obvious increase in the metal around the screw and shanks.

After using these Metzenbaum scissors for a few years certain weaknesses became obvious. For example, if tough or firm fibrous tissue was incised, or if scar or thick inflammatory tissue was dissected these scissors would spring and not cut. This was due largely to the light construction around the screw and in the shank.

We have devised a modification which includes thickening of the metal around the screw and shank. (Fig. 1, No. 2.) We have used these new shears for some months and they are most satisfactory. All the advantages enjoyed with the lighter scissors were saved, and the added strength and cutting power have increased their usefulness and adaptability.

AN INSTRUMENT FOR THE SPINAL SUBARACHNOID INJECTION OF IODIZED OIL

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THE use of iodized oil for the diagnosis of spinal lesions has again become prevalent due to the attempts to diagnose more accurately a ruptured intravertebral disc. It has always proved somewhat troublesome to inject this substance into the spinal subarachnoid space because of the viscosity of the oil. It is for this reason that the following simple apparatus was designed.

This apparatus consists of a Luer-lock adapter, soldered to one end of a coiled silver wire and an ordinary needle adapter soldered to the other end. The coil in the silver wire permits sufficient movement without displacement of the needle in the spinal canal when pressure is exerted upon the syringe. The Luer-lock of the syringe is attached to the opposite end. When the oil is heated and injected in this manner, there is no danger of disconnecting the system. After the injection the stilette is replaced before the withdrawal of the needle to prevent the globules of oil infiltrating into the muscle.

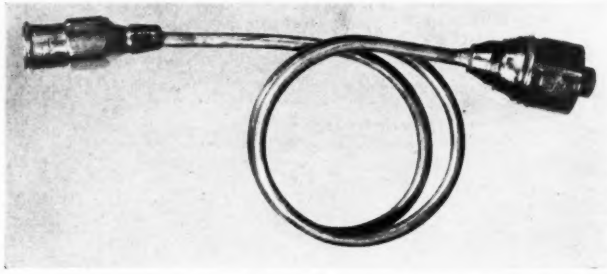

FIG. 1. This coiled tube acts as a spring.

Bookshelf Browsing

LANFRANCO

INCUNABULA MEDICA VI

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LANFRANCO was born in Milan of a fairly well-to-do family. His schooling consisted of private tutoring until the age when it was considered that he was ready for the University at Bologna. Here he expressed his desire to study medicine which fitted in well with the family plans as the social status of a family of those times was materially enhanced if their sons were engaged in either the professions of law or medicine.

As an above-average student he attracted the attention of William of Saliceto, one of his teachers, and upon receiving his medical degree, was given the opportunity of acting as a general assistant in William's surgery and in taking on junior duties as a teacher at the University. For a while he followed this path, but on deciding that he wished to see more of actual bedside activity he went to Milan and practiced there until the year 1290.

Here he incurred the displeasure of one of the powerful families of Milan who in retaliation so engineered matters that Lanfranco was banished from Milan and forbidden to practice either medicine or surgery there. There being nothing more promising to do he returned to Bologna and once again took up his work of teaching and of assisting Saliceto.

After a short period of this work he again became restless and unhappy; therefore, he decided to seek new opportunities in other lands and journeyed to France to the city of Lyons.

Practice here never attained the point he had expected it to either materially or intellectually, so he put his idle time to use by writing a "Chirurgia Parva" which he hoped would be used by his sons in later days. Despite his own setbacks and disappointments, he wished that his sons should follow in his footsteps, study medicine and then devote themselves to surgery. With this thought in mind he hoped to condense into this "Minor Surgery" that which he had found of value in the works of Hippocrates, Galen, Aristotle and the Arabians headed by Avicenna, not failing in the least to give due credit and attention to his teacher and master, Saliceto.

The restlessness which was part of his makeup carried him into many of the provincial towns of France, usually in the neighborhood of Lyons, but as a practitioner of medicine in a small locality he was evidently to experience only failure. Finally, in 1295, he was to reach Paris. Here he was to attain considerable success not only as a surgeon but as a teacher of surgery in the University of Paris.

His instruction had its appeal in that it was real clinical teaching, bedside diagnosis, stressing accuracy in diagnosis, which at that time was a novelty not only in the school at Paris but in all the existing medical centers. He insisted that all cases be studied thoroughly, completely, and that all surgeons should be well grounded in clinical medicine. By this insistence he did much to raise the standards of French surgery and the status of the French surgeons.

His "Chirurgia Parva" was divided into sixteen chapters under five separate headings. The first part was devoted to a description of the qualities necessary for a surgeon. Above all he should be a complete physician; he should recognize the purposes of surgery; and he should possess that idealism so essential to the successful practice of the art. The remainder of this part one is devoted to an anatomy and physiology of the body following out the arrangement of his teacher, Saliceto, devoting each description to a definite region of the body thus keeping it as a topographical anatomy. The second part is devoted entirely to wounds of special parts, and again imitating his teacher, "ad capite ad calcem" (from head to heel) described special surgical anatomy of each part.

The third chapter constitutes a compendium of the general medicine of the time and has the most material if considering the number of pages. It treats of skin diseases, nose and throat ailments, kidney and bladder stone, hemorrhoids, blood letting and sexual malformations.

Fig. 1.

Part four is devoted entirely to fractures and dislocations and their method of reduction, while Part five, follows along an identical line with the "Cyrurgia" of his master, Saliceto, and contains a long list of the more common poisons and the various antidotes for each.

Scattered here and there in this "Chirurgia" were many novelties in methods used and many sound pearls of advice. One in particular, a description in detail of the symptoms of skull fracture with a protest against the too common practice of trepanation in all cases, deserves elaboration. He described the initial state of excessive shock, and states that one of the causes of the high death rate attached is that too many surgeons wish to do a skull trephine when the body is at its lowest point of resistance, therefore, such patients in-

variably die. It was his opinion that trepanation should be reserved for only those cases in which fragments of the skull were depressed causing pressure upon the brain or when the dura covering of the brain was irritated.

As a large number of herniotomies were done by travelling herniotomists, many of whom followed a school of procedure which included castration as a part of the hernia operation, Lanfranco warned that there should be some moderation with regard to this procedure and he advised patients to seek relief by means of a truss and to submit themselves for operation only when all available measures had been exhausted.

His "Chirurgia" became very popular and served to extend his reputation and influence beyond the borders of the Latin world. Many surgeons in other countries, not being sufficiently familiar with Latin, found means of having translations made for their personal use. Most of these translations did not consist of the complete work. Two Hebrew translations were made, one consisting only of the fifth book, the antidotary, which would be very popular and necessary to a general practitioner. One Spanish translation was made of this same book, confirming in a way the popularity of these "Antidotarium." Later an English translation was made of the complete manuscript and was the first anatomical and surgical work to appear in that language. Likewise a French and a German translation was made, all of which indicates the esteem in which the book was held and attests to Lanfranco being a very experienced and wise physician and surgeon.

The manuscript was first printed in Venice in 1490, although an abortive effort was made to publish a French translation in Lyon about 1479. Again its popularity can be estimated from the fact that during the incunabula period of printing four additional editions were printed, all in Venice, in the years 1497, 1498 and 1499.

Because of the political difficulties which at that time beset Bologna, migration of students and faculty away from this center was to result in the birth of centers elsewhere, where, temporarily at least, partial refuge from war and its attendant dislocations was possible. The height each center was to achieve was dependent entirely upon the intellectual capability of the individual or individuals who were drawn there. Thus Lanfranco chose Paris, and because he brought with him the best of the knowledge and technic of Bologna, coupled with what he had accepted as valuable from the Salernitan school, the University of Paris began immediately its rise to world fame, when students from all over the world flocked there for instruction.

There were two other offsprings of the school of Bologna, each destined in due time to achieve its own place in the intellectual and scientific sun.

Padua, was to become by far the more famous of these two. Driven from Bologna by war and persecution, students flocked to Padua in droves and in a short time it was to be the typical university center, with its "Quartier Latin" and nearby Venice. During its career it was to encounter considerable vicissitudes and its place as a center of learning was maintained only under extreme difficulties. Due to the gangster-like tyranny of one of its leading and controlling families, in its early days it sank to a very low ebb and was revived only by pressure and help from the papacy. It lacked in these early days that one feature which seemed an absolute essential to growth and progress, a personality. Had Lanfranco come to Padua its growth would have been more immediate or spectacular. Padua needed a Lanfranco. For lack of such it was destined to wait almost one hundred years before it should reach its peak of accomplishment and then to succumb to that same ever recurring formula—decline and disintegration into nothing.

Montpellier, in France, was the other daughter of Bologna, born because of political intrigue and persecution making it impossible for Bologna to do other than

succumb and decline. The magnificent law school of Bologna and the greatest law school in the world, where first autopsies were made legal, casting about for a newer place in which to convene, moved to Montpellier. The faculty of arts followed, then finally the medical faculty. With such an abundance of material Montpellier flourished for almost three hundred years before it was to meet with any setback, and then only a temporary one, followed by a renaissance and increase in prestige into the sixteenth and seventeenth centuries. Had Lanfranco chosen Montpellier, there is no doubt that immediately it would have stepped into first rank as the leading center of medical thought and teaching. Montpellier, like Padua, needed also a Lanfranco. Why he chose Paris as the place where he preferred to practice and teach, we do not know; possibly it was the influence of geographical proximity only, having practiced in nearby Lyons and in several of the province towns.

The period comprising the thirteenth century was that in which the great Catholic Orders came into being and acquired immediate and enormous influence. In a relatively short space of time this influence was to metamorphose into control. The Dominicans or Black Friars were founded by Saint Dominic who first conceived the idea of a religious order whose purpose it would be to carry the gospel of Christ to infidel and heretic. The Order was founded somewhere about 1215, and the story of its influence upon all of progress and achievement from that time on has been covered in its many phases by many students and authorities.

Originally, their intention was to be a purely mendicant order. Circumstances or times changed this objective, and they soon began to acquire property and to establish monasteries in strategic areas over the whole of Europe. The first of these was at Bologna, the second at Paris.

Another aim, and a natural one presumably, was the development of centers of learning, universities where a systematization of Christian philosophy might be made and taught. In Paris their first efforts were directed toward obtaining a place on the faculty, then the founding of a chair of philosophy, then two chairs, and so on.

In the tremendous strides of their growth, they acquired a tremendous quantity of available manuscripts on the sciences, astronomy, mathematics, law and medicine. Scribes were put to work translating and collecting the available data, but the tragedy of it all is that anything that did not serve their purposes of teaching or was in any way contrary to their own philosophies was destroyed as being of no value. How much was lost by such a process can only be conjectured.

The Franciscan Order, or the Grey Friars, as they were called because of the color of their robes, came into prominence at about the same time. Their theories were entirely different from those of the Dominicans, in fact, almost directly antagonistic. This order made a genuine and honest attempt to adapt a Christian theology to the philosophy of Aristotle and others, even though it disagreed with them in parts.

Both Orders served one essential purpose in man's intellectual progress: They provided shelters or retreats where the more studious could be protected from an outside world when that world became too oppressive or too restricted. Their monasteries provided asylum for those who wanted peace and solitude to think out not only their own problems, but universal problems as well. Possibly that is what we are in need of in our own present day.

These Orders, more particularly the Dominican, first edged in, then took over the centers of research and teaching, finally controlling for some hundreds of years the direction of human thought and effort. In this manner, through able efficient learned personalities, they were to control the direction of medical thought, medical teachings and the start made at

the University of Paris at the time when Lanfranco, greatest Italian surgeon of his day, had brought not only that which constituted the best in Italian surgery, but also all of Arabian medicine and surgery which only a short time previous had been absorbed by the Italian school.

Lanfranco died in Paris in 1308. He and his work constitute one of those links in the chain of dissemination of medical knowledge. The torch of medical progress passed from the hand of Italy to Paris, in France, from where it was destined to be passed onward again, never faltering, continually going forward, for that is and has been a characteristic of science.

THE early Greek physicians and Galen knew that there were such things as internal cancers, but that is about all they knew so far as one can tell from their writings. They blamed the internal cancers on an excess of black bile.

From—"Carcinoma and Other Malignant Lesions of the Stomach"—by Waltman Walters, Howard K. Gray and James T. Priestley (W. B. Saunders Company).

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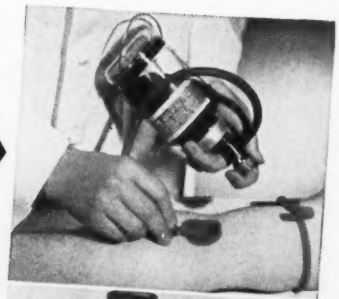

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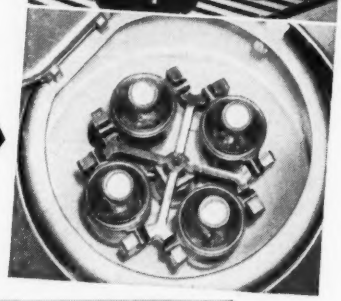

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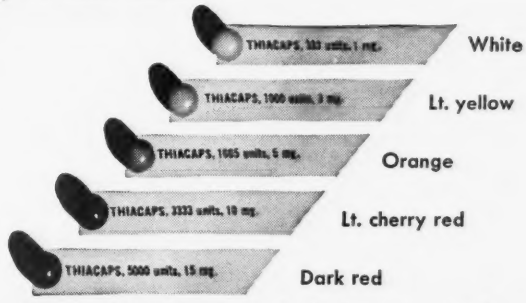

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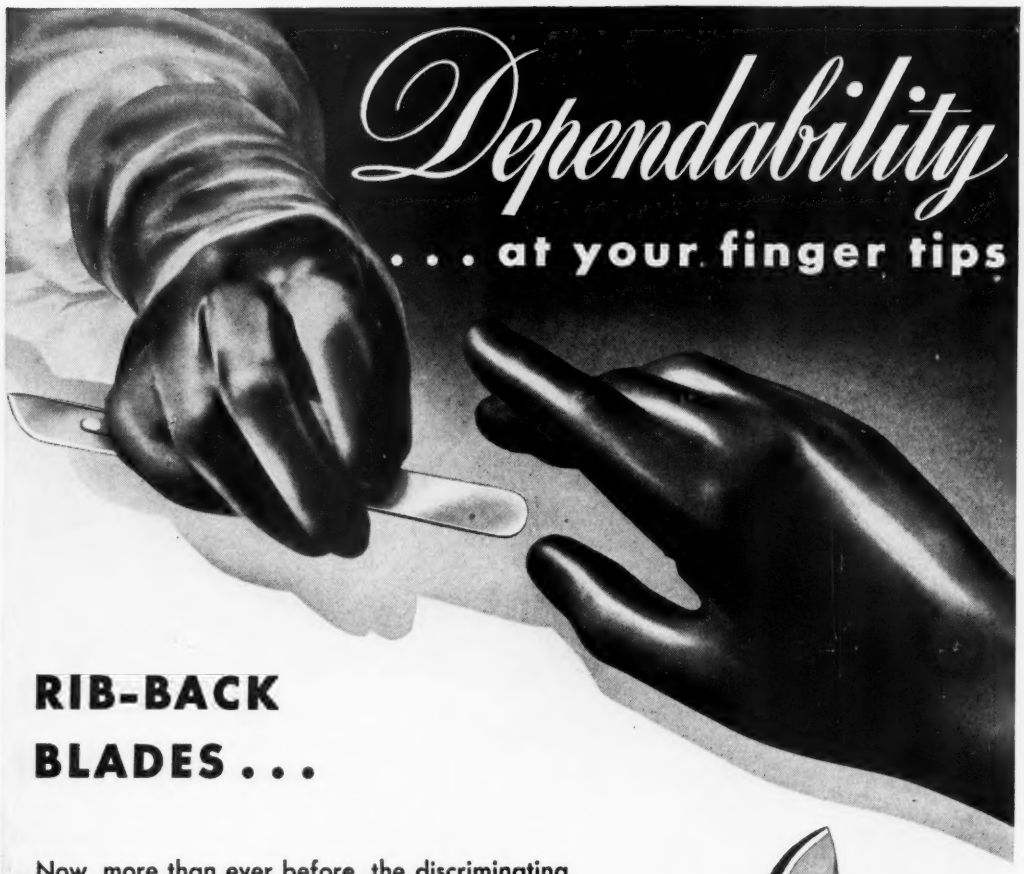

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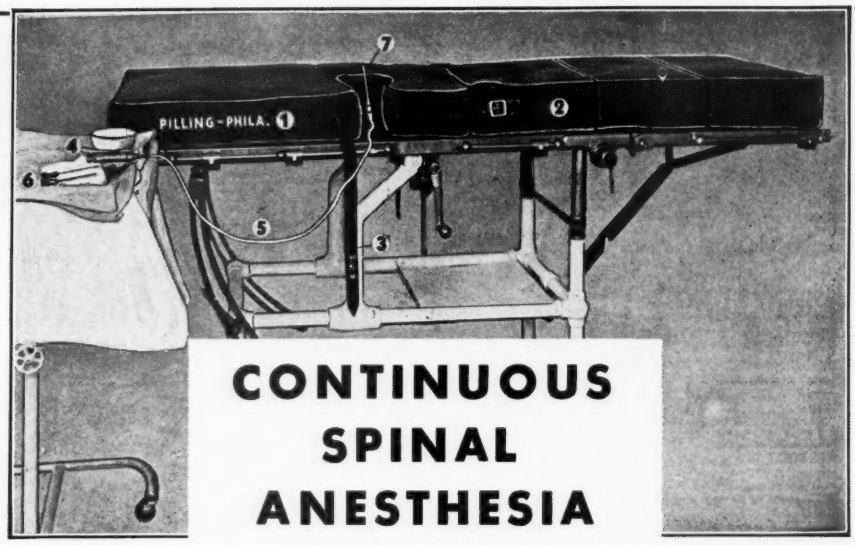

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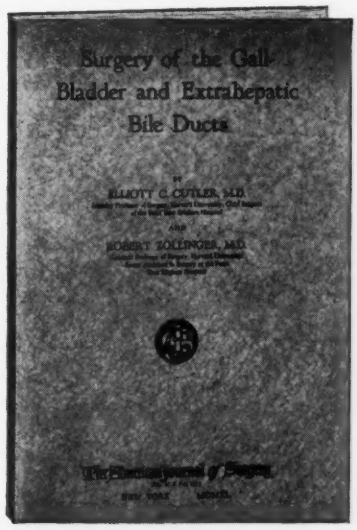

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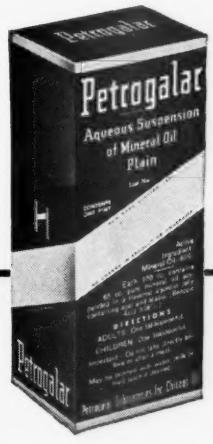

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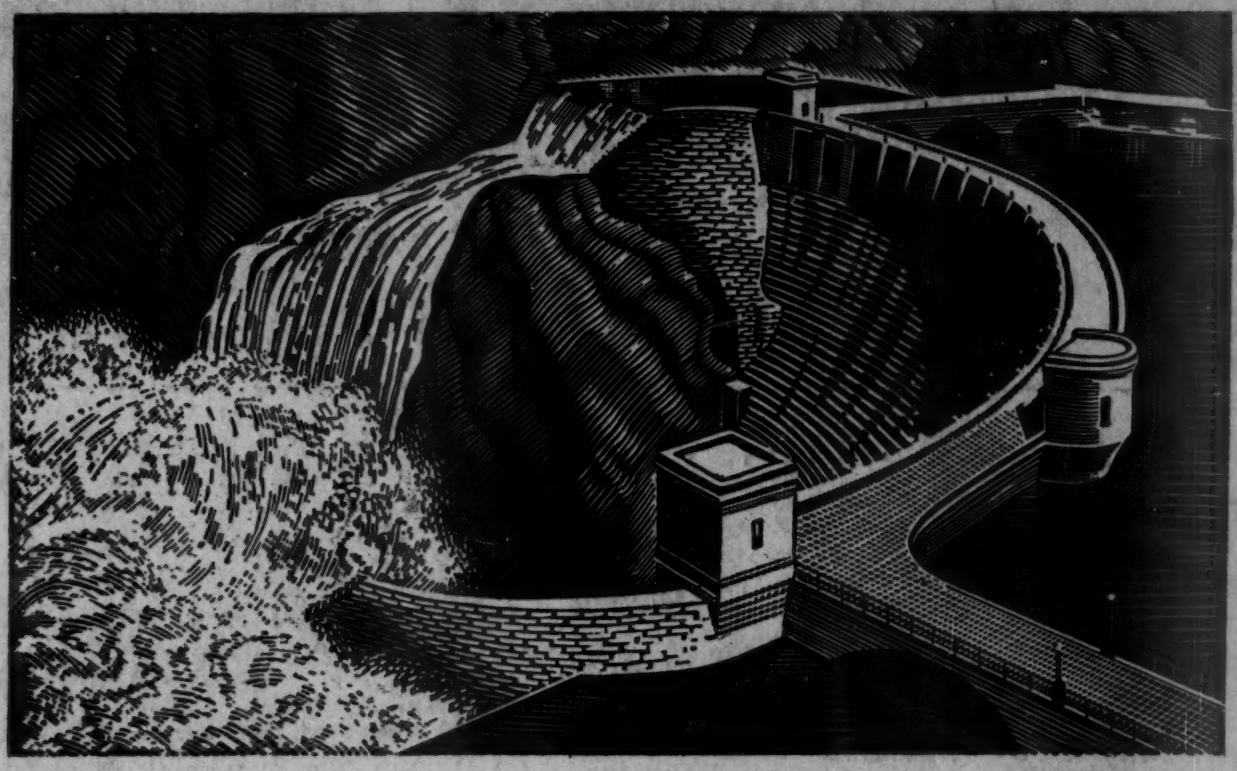

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